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WORKERS' COMPENSATION APPEALS TRIBUNAL BRANCH
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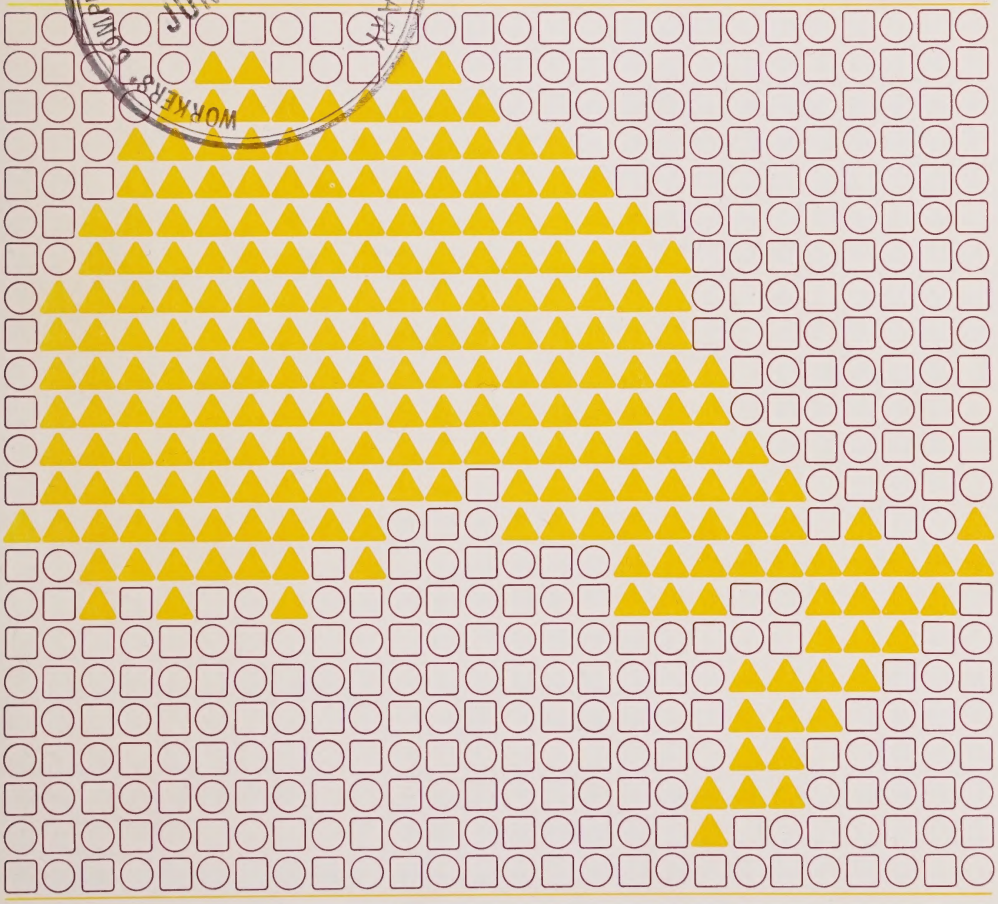
Styrene Exposure in Ontario

Repetitive Strain Injuries – A Preventive Approach

Dealing with Alcohol and Drug Abuse Within the Workplace



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Occupational Health in Ontario

Volume 10, Number 2, Spring 1989

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3. U.S. Department of Health, Education and Welfare. Smoking and Health. A report of the U.S. Surgeon General, 1979.

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Correspondence

To the Editor

Dr. Guidotti's critique of Dr. Atherley's criteria for Medical Evaluation Proceedings is so replete with plangent periphrases and jargon that any message he is trying to convey is obscured by a surfeit of 'genuine dialogues', 'articulated issues', 'outcome monitorings' and 'conceptual frameworks'. I suppose this is to be expected since Americans have always experienced difficulty with English, at least since 1776 or shortly thereafter!

Dr. Guidotti distinguishes between monitoring and occupational health surveillance, but the distinction he chooses to make is not generally accepted, and many persons will speak of monitoring blood lead or ambient TDI levels. Monitoring certainly does not imply, as he would have us believe, the detection of previously unsuspected risks. Perhaps he would do better if he used the term 'screening', since this at least has been defined by the World Health Organization (WHO), and the definition has received fairly general acceptance.[1]

Many governmental agencies both here and in the U.S., including NIOSH and OSHA, have taken upon themselves to recommend and indeed to compel workers to undergo certain screening tests, the validity of which has never been demonstrated. Why, when simple silicosis does not lead to impairment of ventilatory capacity, should a company be compelled to measure not only the FEV_1 and FVC but also the FEF_{25-75}, a test that has long been recognized by all but the neophytes as being variable and almost worthless?[2] Why did the Ministry of Labour initially recommend routine liver function tests on workers exposed to acrylonitrile when these tests may conceivably detect those who indulge too freely in alcohol, but will do nothing to detect occupationally induced hepatic disease resulting from exposure to this designated substance? At least the ministry thought better of the recommendation when they received some critical comments.

A number of criteria for screening procedures has been proposed and accepted by the scientific community. These have been published elsewhere. I would like to add a further criterion, namely, the benefits accruing to the true positive should outweigh the harm done as a result of a false positive diagnosis. The unnecessary worry, unpleasant and often invasive investigations that a subject who has a false positive test inevitably undergoes would make the most resilient and stoical subject cringe. Those who wish to force medical tests on others would do well to remember the marvellous good sense of John Stuart Mill when he wrote 'The sole end for which mankind are warranted, individually or collectively, in interfering with the liberty of action of any of their number is self-protection.' Hence the justification for certain routine tests in airline pilots and train drivers.

I find Dr. Atherley's recommendation 'that medical monitoring should be the subject of explicit legislation by elected representatives, not rule-making by administrators etc.' a chilling thought!

Shades of George Orwell! How can we expect even well intentioned politicians — I have no doubt that such do exist — to make objective decisions when they are constantly being lobbied, pilloried and pressured by a vocal lunatic fringe that is grinding its own axe, not to mention the media which invariably give maximal publicity to horror stories of environmental toxins. As for having faceless Kafkaesque civil servants promulgating such regulations, that, if anything, is even worse and in this I agree with Dr. Atherley. There is a fundamental flaw in having an agency or ministry carrying out research and later enacting and enforcing legislation based on their own research. Those who make the laws should not also act as enforcers or policemen. In this context the only way of making objective decisions depends on seeking the advice of a committee of experts. The Canadian Task Force on Health Surveillance of Workers should serve as an example.[3]

The problem of health surveillance is fraught with difficulties, but perhaps the best advice in this regard is to be found in a recent statement of the Advisory Council [on Occupational Health and Occupational Safety] to the Ontario Ministry of Labour. This defines medical surveillance as 'the continuing or periodic examination of groups of workers for the purpose of diagnosing impairment or disease. Such surveillance may include serial physical examinations, biological testing of body fluids, and selected appropriate laboratory tests.'[4]

The council then went on to make three important recommendations.

a) that worker participation in health surveillance be mandated only in circumstances where it would identify a medical condition that would prevent a worker from performing his or her job safely, thereby causing a significant risk to the health or safety of the public or other workers, and where there are valid and effective procedures to make such a determination.

b) that the Minister of Labour ensure that an employer is required to offer and pay for health surveillance programs that can be demonstrated to be a 'precaution reasonable in the circumstances for the protection of a worker' and where there are valid and effective tests.

c) that the Minister of Labour develop a mechanism involving labour and management to appoint a committee of independent medical and scientific experts to advise the minister as to whether particular biomedical surveillance procedures are valid and effective, and whether they are reasonable precautions for protecting workers' health.

No, Dr. Guidotti, although your position has a meretricious veneer of plausibility, your doctrinaire approach simply will not do. I am as much in favour of research as you are; my approach is, however, different. Should you wish to do epidemiological research, I suggest that you contact the union concerned, the employers, and the workers and explain to each what you want to do and why. You are likely to be successful and will probably obtain excellent co-operation. Moreover, the data that you will gather will certainly be better and more reliable than those obtained as a result of some governmental edict. You put forward the notion that an alternative 'strategy' (do you mean an alternative approach or alternative tactics?) would be one 'in which organized labour and responsible governmental agencies protect

the interest of the worker on an institutional basis by sponsoring, supporting, or monitoring the integrity of data-gathering activities with built-in safeguards.' How can we rely on a government, no matter whether provincial or federal, and irrespective of political party, to make realistic regulations when it is constantly pressured by various lobbies, each of which is riding its own hobby-horse and is supported by the media whose viewers and readers invariably prefer exaggeration and flamboyance? When it comes to toxins and chemicals, even small risks are better than no risks at all, at least as far as newspaper circulation and the number of TV viewers are concerned. Thus, the evidence that PCBs have ever induced cancer in humans is non-existent.[5] One only has to look at the huge sums of tapayers' money that have gone into investigating the effects of formaldehyde, a mild but otherwise harmless irritant, and, by the same token, the fictitious foetal abnormalities that have been said to be induced by exposures to PCBs and other chemicals from the Love Canal, and which were subsequently shown to be non-existent by a study conducted by a group of experts appointed by the State of New York, to realize that Dr. Atherley is indeed correct when he maintains that medical research is a multimillion dollar industry. Even so, research can still be well worthwhile if the money is put to good use; but, unfortunately, pressure from the uninformed often ensures that precious resources are wasted on inconsequential matters.

Finally, neither Dr. Atherley's nor Dr. Guidotti's proposal is the answer. May I call Dr. Guidotti's attention to the remarks of Thoreau, a countryman of his: 'If I knew somebody was coming to my house, uninvited, with the express intention of doing me good, I would run for my life.' So would I if someone were coming to 'medically survey' me against my will!

Yours,

W.K.C. Morgan, M.D.

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[5]Urabe H, Koda H, Asahi M. Present State of Yusho Patients. Ann N.Y. Acad Sci 1979;320:273-282.

Dr. Guidotti's response to Dr. Morgan's letter is printed below.

To the Editor

I found Dr. Morgan's letter amusing and am pleased that he found my article worthy of his exercise in erudition. Prolonged residence among Americans seems not to have diminished Dr. Morgan's own writing style, which borrows heavily from his countryman Trollope. He has failed to notice an irony, however: he criticized my use of language on the one hand and then disparaged my insistence on precise and useful definitions on the other.[1,2] This is not very consistent. However, it is not rhetoric that is at issue but the health of Canadian workers and the social philosophy that provides the context for protecting their health.

Dr. Morgan's familiarity with John Stuart Mill's *On Liberty* appears to stop before Chapter 5, where he might have encountered Mill's own response to the issue he raised: 'As the principle of individual liberty is not involved in the doctrine of free trade, so neither is it in most of the questions which arise respecting the limits of that doctrine, as, for example, . . . how far sanitary precautions, or arrangements to protect workpeople employed in dangerous occupations should be enforced on employers.' Mill took care to exclude from his argument arrangements in which workers give up their basic rights to health and life: 'In this and most civilized countries . . . an engagement by which a person should sell himself . . . would be null and void . . . [By] selling himself for a slave, he abdicates his liberty . . . The principle of freedom cannot require that he should be free not to be free.' Mill also understood that society may require information on individuals in order to fulfil its duty of collective self-protection. Later in the same chapter, for example, he advocates examinations of children in order to ensure that parents are doing their duty in providing for their education. The argument for examining workers to ensure that employers are dutiful is similar and does not rest on any assumption of paternalism.

Dr. Morgan puts forward two particularly lame examples of mandated surveillance and would have us believe that they represent the state of the art in monitoring technology and that practitioners of occupational medicine are and must remain oblivious of the concept of predictive value. He makes no mention of the imminent introduction of biological exposure indices and other tests far more sensitive and specific for evaluating exposure and individual risk. Even so, let us confine ourselves to the clinical tests routinely available and use his own example of silica-exposed workers. We recently began a (union-supported) surveillance program for refractory brick workers. Among the first 18, several already have shown abnormalities — some in their chest films but mostly in their audiograms! (Dr. Morgan, as a pulmonary physician, may feel little responsibility for their hearing, but occupational physicians cannot be so narrowly focused.) Here is a group in which existing controls on exposure were not working. Protecting the health of workers by controlling exposure is certainly the objective, but when that fails, health surveillance is the next line of defence. Drs. Morgan and Atherley appear to assume that compliance to exposure standards can be made perfect but that surveillance and monitoring strategies can never be improved; the literature and common sense refute their assumptions.

There are also other types of medical evaluations besides periodic health

surveillance. Fitness-to-work evaluations protect the rights of the employer and other workers who could be harmed by the incapacity of their co-workers.[4] Research strengthens society's ability to protect its members. Much research in occupational health medicine depends on the collection of accurate health and exposure information specific to individuals.[5] Had this information been collected more widely and systematically in the past, Dr. Morgan and I might be able to resolve our long-standing disagreement over whether exposure to silica (in modern times) confers an elevated risk of lung cancer.

We are not in the happy position of being able to identify with certainty in advance all the health risks or, for that matter, all the hazards in the workplace. We have a generally poor and spotty data base for humans on exposure-response relationships to support standards setting. In this and many other examples, ignorance is not an improvement over knowledge, even among libertarians, because true freedom to act requires sufficient information and understanding on which to base effective action. The alternative to 'medical monitoring' is to guess, hope, and pray that the body count does not prove us wrong. Despite the tidy quote from Thoreau, I doubt that he would have strenuously objected to the arrival of an uninvited fire brigade disturbing his peace at Walden, even if the fire on the roof of his cabin it extinguished had initially escaped his notice.

Much of Dr. Morgan's letter seems to have little to do with anything I actually wrote, although I am pleased that my article inspired him to compose. I would like to close with a quotation from a contemporary of Mill, Matthew Arnold:

Physician of the Iron Age . . .
He took the suffering human race,
He read each wound, each weakness clear —
and struck his finger on the place
and said — Thou ailest here, and here.

Sincerely,

Tee L. Guidotti, M.D., M.P.H., FRCP(C), C.C.B.O.M.

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Styrene Exposure in Ontario

Summary

A survey of the plastics moulding and fibreglass-reinforced plastics industry was conducted to assess styrene exposures in view of pending legislation for compliance with a 50-ppm exposure limit. A total of 84 plants representative of the industry were visited and air sampling results from 69 were obtained. Industry-wide, 49 per cent of air samples exceeded 50 ppm.

In the fabrication of large articles — yachts, pipes and tanks — there is considerable exposure in the range of 50 to 100 ppm, even with extensive local exhaust ventilation. There is limited use of other control

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Introduction

The users of styrene are a diverse group: (i) styrene producers; (ii) polyester resin manufacturers; (iii) producers of styrene-based plastics (polystyrene, styrene/acrylonitrile (SAN), acrylonitrile/butadiene/styrene (ABS), etc.); (iv) manufacturers of styrene-based moulded articles; (v) fibre-reinforced plastics (FRP) industry.

The production of styrene monomer and its conversion to polymeric raw materials constitute the major sources of exposure to styrene.[1] These processes are carried out at elevated temperatures and pressures and therefore must necessarily be isolated and enclosed.[2] It is recognized that occupational exposures in categories (i) to (iii) are low because there is little or no venting to the workplace atmosphere. In the moulding of articles using polymeric styrene-based plastics, i.e. polystyrene, SAN and ABS, thermal degradation does not produce significant concentrations of airborne styrene.[3,4]

The FRP industry uses open moulding and spraying techniques involving polyester-based resins and paints containing styrene. Although the FRP industry constitutes less than 10 per cent[5] of the total styrene usage, it is generally recognized that this is the industrial sector of prime concern regarding occupational exposure to styrene. This survey was conducted by the Health and Safety Support Services Branch of the Ontario Ministry of Labour, with prime reference to the FRP industry and a lesser focus on the moulded plastics industry, to assess industry compliance with a 50 ppm control limit for styrene within the three-year time frame as proposed in the draft Designated Substance Regulation dated March 15, 1986. This study serves as a follow-up to a previous study conducted for the ministry in 1981 by the Occupational Health and Safety Resource Centre, University of Western Ontario.[6]

Selection of Plants

Plants were selected from known styrene users. In order to encompass the maximum number of employees,

options in the FRP industry. Engineering controls are largely absent during the production of small- or medium-sized articles, but exposures are generally below 50 ppm. Exposures during the automated moulding of styrene-derived plastics are insignificant.

Key Words: styrene, hygiene survey, lamination, chopper-gun, gel-coat, fibre-reinforced plastics

plants and high-risk job catagories, companies were excluded from visitation if: (i) only very small quantities of styrene-based products were used; (ii) the companies were producers of styrene monomer or blenders of products containing styrene monomer; (iii) the plant had been visited by the ministry within the previous 12 months, i.e. 1987.

A total of 84 plants comprised the survey. Hygiene walkthroughs were made, and information pertaining to the products produced, styrene usage, work practices and control measures was obtained. As production in the FRP industry is subject to seasonal variations, especially during winter for the sector fabricating customized products, air sampling was carried out in 69 plants according to the suitability of production schedules. The lesser number of air sampling visits relative to hygienist walkthroughs is a reflection of the lead time required for analysis.

Plants are classified by industry in Table 1. Relatively few plastics moulding companies were selected because of the primary focus on the FRP industry. The manufacture of FRP automotive parts and customized articles constitute the majority of workplaces; hence, a comparatively large number of plants from this sector were chosen for visitation.

Table 1 **Classification of Visits**

Manufacturing Sector	No. of Visits	No. of Air Sampling Surveys
Marine (Yachts)	15	12
Tanks and Pipes	9	7
Custom and Auto	36	29
Domestic and Recreation	17	15
Plastics Moulding	7	6
Totals	84	69

Sampling and Analysis

Air sampling surveys were carried out by technicians of the Occupational Health Laboratory Service, Ministry of Labour. Personal samples were obtained for laminators, chopper-gun operators and gel-coat sprayers. Since lamination is the most prevalent operation in the FRP industry, the majority of samples were acquired for that job category. The samples were obtained as representative of personal eight-hour exposures. Exposure durations generally exceeded four to five hours where operations were continuous, but where production was

intermittent, e.g. in small, custom operations, sampling was chosen to coincide with the available production as a basis for estimation of personal exposures.

Samples for styrene were collected by drawing air through activated charcoal tubes, at a flow-rate of 100 cc/min. Sample analysis was carried out at the Occupational Health Laboratory of the Ministry of Labour by the NIOSH S30 gas chromatographic method utilizing a FFAP column and flame ionization detector.

Results and Discussion

A summary of the air sampling data by sector and job category is shown in Table 2. The geometric mean values for individual operations in the various sectors were determined from the air sampling data and are also presented in Table 2.

The data for lamination in the marine sector are shown as a conventional log-probability plot in Figure 1. The results of the previous (1981) survey[6] are given for comparison; a summary is provided in Table 3.

The type and extent of control measures in the various manufacturing sectors are summarized in Table 4. Use of respiratory protection is presented in Table 5.

Hand-lamination, gel-coat spraying and chopper-gun usage are generally common to all sectors of the FRP industry (plastics moulding excluded) and vary only in extent. Since the styrene-containing resins are applied in successive layers, the generation of airborne styrene is dependent upon the area of evaporative surface exposed and, consequently, on the amount of resin consumed; large consumers of resin present the greater potential for worker exposure.[5] Boat manufacture represents a major concern in that large surface areas are exposed and large volumes of resin are used (up to 7,000 gallons per month).

As in the marine sector, the fabrication of tanks and pipes by hand-lamination, chopper-guns or filament-winding can involve large evaporative surface areas; hence, styrene exposure levels tend to be comparable (Table 2). In some instances, short-term exposures exceed 200 ppm in the absence of controls, e.g. exposures up to 228 ppm over a 45-minute period were recorded during chopper-gun spray-up/rolling of pipes and 195 ppm over a 33-minute period during tank lamination.

The plants producing automotive and custom articles are generally small, with only a few employees, and, consequently, have relatively low resin consumption: usually less than 500 gallons per month. The surface

Table 2 Styrene Exposure by Sector and Job Category

Sector	Operation	No. Samples	Styrene Concentration (ppm 8-hour TWA) Geometric Mean	Range	% Samples Greater than 50 ppm
Marine	Lamination	69	43	8–191	49
	Lamination (Small Parts)	14	21	9– 60	7
	Chopper-Gun	8	20	13– 50	–
	Gel-Coat	10	22	7– 70	20
	Miscellaneous	6	6	2– 35	–
	Total	107	31	–	30
Tanks and Pipes	Lamination	17	28	14– 72	8
	Chopper-Gun	2	54	53– 56	100
	Filament-Winding/ Chopper-Gun	20	42	17–122	52
	Gel-Coat	1	49	49	0
	Total	40	40	–	41
Custom and Auto	Lamination	56	23	1–129	21
	Chopper-Gun	10	16	2– 48	–
	Gel-Coat	14	27	13– 74	7
	Miscellaneous	4	5	2– 9	–
	Total	84	22	–	19
Domestic and Recreation	Lamination	37	12	1– 58	3
	Chopper-Gun	13	16	8–117	15
	Gel-Coat	11	13	1– 27	0
	Total	61	13	–	5
Summary	Lamination	217	28	191 (max)	28
	Chopper-Gun	33	20	117 (max)	13
	Gel-Coat	36	20	74 (max)	14

areas exposed are relatively small, comparable with small-parts lay-up in the marine sector. Styrene exposures, likewise, tend to be below 50 ppm.

The domestic and recreation sector encompasses both large and small consumers of resin: 200 to 5,000 gallons per month, excluding low-level repair operations. Air sampling results indicate that, as with small-parts lay-up, lamination in this sector of the FRP industry generally produces exposures below 50 ppm on a time-weighted average basis. Of all the air samples taken, 95 per cent were below 50 ppm and 82 per cent below 30 ppm.

Figure 1. Lamination, Marine Sector. Log-Probability Plots for Personal Samples.

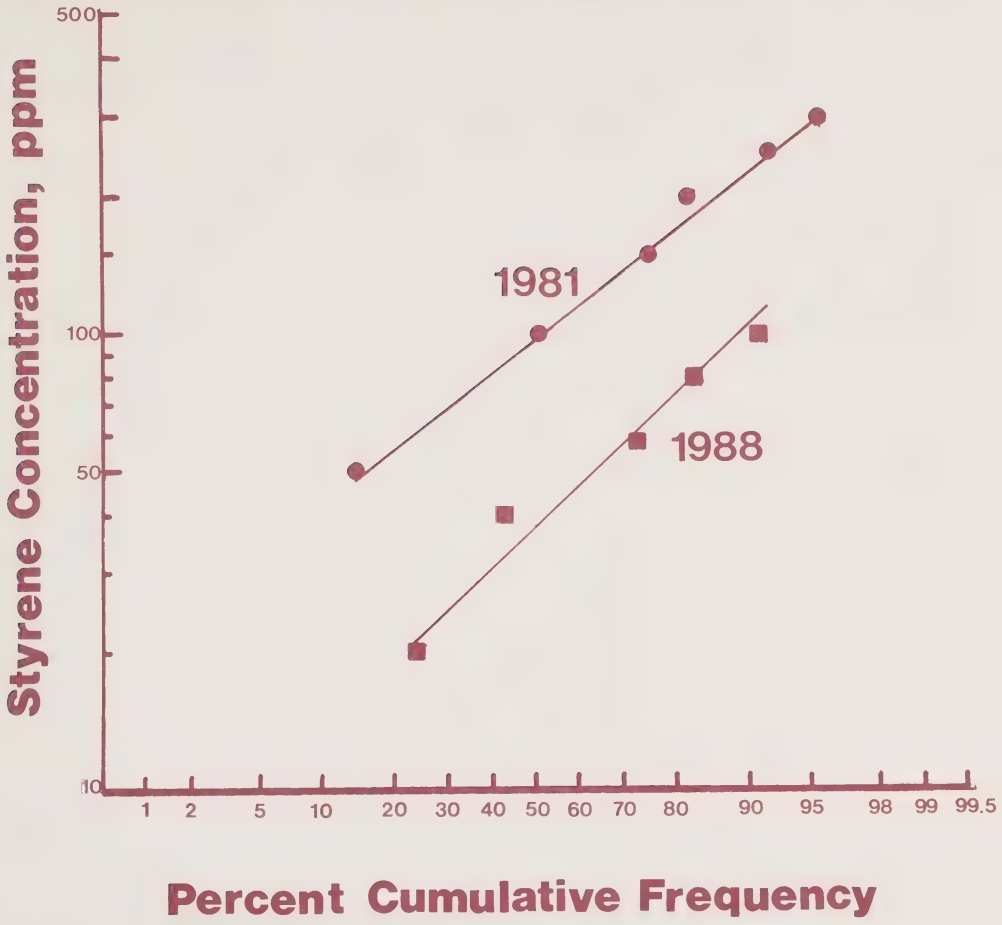

Table 3. Comparison of Sampling Results

	1981	1988
# Air Sampling Surveys	4	12
# Personal Samples	66	83
Average Styrene Concentration (Geometric Mean)	100 ppm	43 ppm
% Samples > 50 ppm	86	42
% Samples > 100 ppm	49	9

Table 4 Ventilation Summary*

Sector	No. of Plants	Make-up Present	Local Exhaust (Lamination)	Chopper-Gun	Chopper-Booth	Gel-Coat Spray	Gel-Coat Booth
Marine	15	3	6	8	3	14	9
Tanks and Pipes	9	3	6	4	1	1	1
Custom and Auto	36	6	6	17	12	19	15
Domestic and Recreation	17	4	6	12	11	8	7
Plastics Moulding	7	4	4	–	–	–	–
Totals	84	20	28	41	27	42	32

*The figures refer to the number of plants that have the particular operations or controls.

Table 5 Respiratory Protection Summary*

Sector	No. Plants	Respirators		No. Bearded Users
		Organic Vapour	Dust	
Marine	15	15	4	1
Pipes/Tanks	9	7	1	
Custom/Auto	36	31	11	2
Domestic/ Recreation	17	14	7	1
Total	**77**	**67**	**23**	**4**

*Figures refer to number of plants in which respirator use was noted.

The manufacturers of styrene-based moulded articles utilize polystyrene, SAN or ABS in pellet form (up to 8,000 kg of pellets per day). Air sampling results indicate that styrene concentrations in emissions from actual plastics moulding operations are insignificant. It is noted, however, that during pre-foaming of polystyrene raw material (prior to blow moulding), styrene levels of 20–30 ppm were measured (colorimetric detection tubes); pre-foaming is a precursor to moulding rather than an actual moulding operation.

Ventilation Controls

i) Marine Sector

The major ventilation control strategies employed during the manufacture of large items, such as boats, include dilution ventilation, local exhaust and push-pull

ventilation; dilution ventilation is the most common approach.[7] All marine plants surveyed have mechanical exhaust through a combination of roof- or wall-mounted fans and exhaust through spray booths. Local exhaust for hand lay-up is provided in six of the 15 plants surveyed. No use of localized push-pull ventilation systems was observed. The provision of mechanical make-up air is the exception rather than the rule — one-quarter of plants, confined to the largest users — and, consequently, the exhaust may generally be operating below optimum capacity.

In this sector, gel-coat provides the decorative outer layer and spraying is generally performed in booths for quality control. Chopper-guns are generally used only for the spray-up of small parts; owing, perhaps, to the proliferation of these articles during yacht manufacture, the inconvenience of transferral between various areas of the plants and the difficulty of manipulating articles inside booths, chopper-guns are generally used outside the booths and also without local ventilation.

Exposures of laminators generally do not exceed 100 ppm as a time-weighted average but do exceed 50 ppm because workers are in close proximity to large evaporative surfaces and local exhaust is seldom used. General ventilation is too remote to provide effective control at source for reducing personal exposures; in some cases, short-term exposures exceed 200 ppm.

One of the largest resin consumers, using about 2,000 gallons per month, also has the highest exposures: a TWA exposure up to 191 ppm with a short-term maximum of 260 ppm. The canopy-type controls, which were reportedly inoperative at the time air sampling was conducted, are unlikely to reduce exposures significantly since airborne styrene would be drawn through a worker's breathing zone before being exhausted.

A boat fabrication plant included in the 1981 study[6] is also included in the current study. The installation of a flexible-duct exhaust system appears to have reduced exposures significantly (5,000 gallons of resin per month, range of TWA exposures 49–81 ppm, maximum 150 ppm), compared with conditions prior to this control measure being implemented (range 28–327 ppm). Exposure at this plant is comparable to that of another plant utilizing only half as much resin (3,000 gallons per month, range 16–79 ppm, maximum 212 ppm) in the absence of local exhaust.

An example was noted of a ventilation system consisting of peripheral exhaust and employing dispersion of styrene vapour by make-up air introduced through

flexible ducting and peripheral vents. Considerably less resin is used at this plant, about 1,000 gallons per month, yet exposures are comparable (range 30–99 ppm, maximum 160 ppm) to the plant mentioned previously with no exhaust provided. The effectiveness of the exhaust/dispersion system is therefore questionable.

The marine sector requires a considerable amount of fabrication of small parts. Small-parts lay-up is generally seen to produce exposures below 50 ppm, even without local exhaust ventilation. Hand-lamination of large parts, however, can result in significant exposure, even in the long term; short-term exposures, as mentioned previously, can exceed 260 ppm.

The results suggest that improvements have been made in the industry, in that the average (geometric mean) exposure level has been reduced from 100 ppm to below 50 ppm. There remains, however, considerable exposure above 50 ppm: approximately half of the samples taken during lamination exceed this time-weighted average exposure value. Most of the yacht fabricators have some exposures in excess of 50 ppm as a time-weighted average. More effective controls than those currently in place will be required to bring the marine sector into full compliance with a 50 ppm standard. It is noted that only some of the largest plants have attempted to use local exhaust ventilation as a control measure during lamination; financial considerations are obviously a major factor influencing the implementation of local exhaust.

According to the available literature, mean styrene exposures during hand-lamination can be reduced below 50 ppm.[7,8] Strategies include push-pull mould ventilation systems, high velocity (turbulent mixing) dilution ventilation, use of strategically placed recirculating air jets in conjunction with good general ventilation, provision of an air curtain between the worker and the mould, and the use of tiltable hull moulds over a slot exhaust located in the floor.

Although less preferable than local exhaust (from an industrial hygiene standpoint), rapid dispersal of styrene accumulations through the use of forced mechanical ventilation (fans) is a viable method for the reduction of styrene exposures.[9-11]. Up to a 50 per cent reduction in exposure can be achieved when a fan is used to blow fresh air from behind a worker towards a mould. Exposures of less than 50 ppm, however, can be anticipated in the presence of good general ventilation and production limited to small or medium-sized flat objects.[8]

Little use has been made of this control option on the Ontario scene.

ii) Non-Marine Sectors

Approximately twice as much use is made of local exhaust ventilation in the pipe/tank sector than in the marine sector, probably because pipes and tanks are more regular in shape than are yacht components and can be fabricated in fixed locations, a practice conducive to the installation of a fixed local exhaust system. Where local exhaust is present, it consists of either flexible ducting or fixed ducting near lay-up or filament-winding operations. Without isolation, this type of local exhaust is relatively ineffective owing to the long lengths of pipe fabricated. Little use is made of booths or other isolation procedures. Permanent fixed enclosures may be inappropriate where customized articles of varying size are produced, but the use of temporary enclosures during protracted periods of lay-up or filament-winding is not evident.

Of the auto/custom plants surveyed, less than half use spray-up procedures (spray-up is generally done in a booth or enclosure). Even with this type of control, the short-term exposures of spray or chopper-gun operators still exceed 100 ppm. In the long term, however, time-weighted average exposures were found to be less than 50 ppm. On the average, exposure is less than 20 ppm, even without local ventilation. Only six out of 36 plants surveyed had local exhaust ventilation for hand lay-up. Despite a general lack of this desirable control feature, most of the plants in this sector would appear to be in compliance with a 50 ppm time-weighted average exposure limit, largely as a result of administrative controls inherent in the production of customized articles. Short-term exposures in excess of 100 ppm occur in a minority of cases (six out of 36 plants visited). These exposures occurred during chopper-gun usage in booths, chopper-gun usage without booth enclosure, gel-coat spraying in a booth and hand lay-up during lamination with and without local exhaust. As is generally found throughout the industry, significant styrene levels can be generated by chopper-gun usage and gel-coat spraying, even with controls.

The domestic and recreation plants involve considerable hand-lamination and fairly extensive use of chopper-guns and gel-coat spraying (12 out of 17). Virtually all spraying is done in booths, but lay-up is in the open, without controls. High styrene levels, up

to 223 ppm, were measured in booths during spraying. Given the nature of the operations and products, high levels during spraying may be unavoidable. This sector has, however, used engineering controls (booths) where styrene levels exceed 50 ppm as a time-weighted average.

Processes such as injection moulding, extrusion and blow moulding are common in the plastics moulding industry. Local exhaust ventilation was present in about half the plants visited, not as a control for styrene (which is only present at insignificant levels) but for the acrid contaminants generally present in most plastics moulding plants.

Substitution

Recently, a group of styrene-suppressed or environmental resins have been introduced for use in the FRP industry. These low-styrene-emission (LSE) resins contain a surface-active ingredient that forms a protective barrier after lay-up. The barrier reduces styrene emissions during the curing process and keeps background levels to a minimum.[12] Reportedly, over 90 per cent of Swedish companies now use LSE resins.[13] Air sampling results from a Finnish study[14] indicate that the use of LSE resins can reduce worker exposures up to 72 per cent during hand-lamination and up to 31 per cent during spray-up. Despite their proven effectiveness, LSE resins have not yet received wide acceptance by the FRP industry in Ontario; in the present survey, only one instance of use was found. Because of problems with odour, use of this resin was discontinued.

Work Practices and Administrative Controls

Exposures in the marine sector can vary considerably owing to the diverse nature of the parts and operations involved. There would therefore seem to be scope for further reduction of individual exposures by means of appropriate administrative controls such as rotating employees in 'high-risk' categories through operations with lower styrene exposures.

Training in, and the subsequent implementation of, good work and housekeeping practices can produce significant reductions in exposures to styrene and other chemicals.[11] Other than obvious procedures relating to safety, there was little evidence from the present survey of the application of such work practices.

Respiratory Protection

The appropriate respiratory protective equipment for styrene is an air-purifying respirator with NIOSH (or

equivalent) approval for organic vapours. This equipment is provided in all of the boat plants and in most of the plants in the other sectors (total: 67/77, Table 5). Although the equipment is supplied in the majority of plants, it is not always used. The reasons include: employee reluctance; employer indifference; company policy of voluntary use; little or no perceived hazard by employees or employers; lack of knowledge or information on the part of employees or employers; discomfort in using respirators; and actual low levels of airborne styrene.

The survey results indicate also that there is considerable use of inappropriate respirators; in almost one-third of the FRP plants (23/77) dust respirators were observed to be used by employees in the mistaken belief that they provided protection against styrene vapour. In many of these instances, however, the styrene exposures would not have exceeded 50 ppm, but the practice illustrates an apparent widespread lack of knowledge, particularly in the custom/auto and domestic/recreation sectors. In a small number of cases (4/77) bearded individuals were observed to be wearing inappropriate respirators. Users and management alike do not appear to be aware that a good facial seal is required for the effective use of the respirators. Respirator training programs throughout this industry therefore require considerable upgrading.

Conclusions

Average exposures (geometric means) in all sectors of the FRP industry are below 50 ppm. Exposures during small-parts lay-up in all sectors are generally below 50 ppm, even in the absence of local exhaust.

In the current survey 49 per cent of the samples taken in the FRP plants exceeded 50 ppm. Short-term exposures can exceed the legislated short-term (15-minute) exposure limit of 200 ppm, particularly during spraying operations. During lay-up of large articles — large boat parts, tanks and pipes — time-weighted average exposures are in the range of 50 to 100 ppm.

Dilution ventilation remains the most prevalent of controls, with only the largest producers utilizing local exhaust ventilation or dispersion techniques. Substitution, administrative controls and modified work practices have not been systematically used. Together with engineering controls, there remains considerable scope for further reduction of exposure throughout the industry.

Résumé

Une étude de l'industrie du moulage du plastique, et du plastique renforcé à la fibre de verre, a été effectuée pour mesurer l'exposition au styrène en attendant l'adoption imminente d'une loi limitant l'exposition au styrène à 50 p.p.m. On a rencontré 84 représentants de fabricants et obtenu les résultats d'analyses d'échantillons d'air de 69 usines. Pour l'ensemble de l'industrie, le taux de styrène dépassait 50 p.p.m. dans 49 pour 100 des échantillons d'air.

L'exposition à un taux de styrène variant de 50 à 100 p.p.m. est considérable dans les usines de fabrication de gros articles — bateaux, tuyaux et réservoirs — même lorsqu'on dispose sur place d'un important système de ventilation aspirante de l'air vicié. L'utilisation d'autres moyens de contrôle est assez restreinte dans l'industrie du plastique renforcé à la fibre de verre. La plupart du temps, les moyens de sécurité intégrée pendant la fabrication d'articles de petite et de moyenne tailles sont absents, mais l'exposition est, généralement, inférieure à 50 p.p.m. L'exposition pendant le moulage automatisé de matières plastiques dérivées du styrène est insignifiante.

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Repetitive Strain Injuries – A Preventive Approach

Summary

Repetitive strain injuries account for a significant and increasing proportion of workers' compensation costs for industrial occupations. This paper identifies the specific elements of repetitive work tasks that contribute to injury. Techniques for injury prevention are then discussed under the headings of task design, workplace design, equipment, machinery and tool design, rate of work and work practices. Attention to these details of repetitive work tasks can greatly reduce both the incidence and severity of injury.

Key Words: repetitive strain injuries, ergonomics, prevention

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Repetitive strain injury (RSI) is the collective name given to muscle and tendon injuries whose common cause is the continuous hand and body movements required for various forms of repetitive work. The resulting diagnosis may be tenosynovitis, tendonitis, peritendonitis, carpal tunnel syndrome, ganglion, epicondylitis, or other injuries or fatigue associated with the neck and shoulder muscles.

Incidence

Injuries resulting from continuous repetitive work were first documented in the early 1700s.[1] In Ontario's work force, repetitive strain injuries account for a significant and increasing proportion of Workers' Compensation Board (WCB) costs. In 1985 the average cost of an initial WCB claim for repetitive strain injury in Ontario was $4,600. The cost is significantly higher than the average WCB cost for all initial claims made in the same year.[2]

The apparent increase in the incidence of repetitive strain injuries may be due to the current trend for specialization and fragmentation of work tasks into short, frequently repeated, cycles. There is also an increased recognition and reporting of repetitive strain injuries as workers and the medical profession become more knowledgeable about the symptoms and their associated work actions.

Work Characteristics

Several specific characteristics of repetitive work tasks combine to determine the risk of a worker developing repetitive strain injury. Variables that influence the incidence of injury include speed, force and direction of movement, rate and total number of movements, relative arm and hand position, smooth or ballistic movement patterns, static muscle effort related to posture and body position, and chronic exposure to vibration.

Specific hand and wrist movements are associated with the symptoms of repetitive strain injury. The ideal

work position for the hand and wrist maintains the posture achieved when the arm and hand are hanging relaxed at the worker's side. In this 'neutral' position (with the hand in alignment with the lower arm) the wrist and fingers can exert a maximal force. When the wrist is bent to the extremes of the range of motion, there is an increased stress on the muscles and tendons, which, in turn, increases the risk of injury. Work actions performed over an extended period of time involving frequently repeated rotation of the joint, such as twisting or wringing, should be avoided. Repeated work movements that require extreme pressure or grip strength should be eliminated. Wherever possible, the pinch grip should be replaced by a power grip, which uses the larger muscles of the forearm. The small muscles of the hand and forearm used in the pinch grip tire much more quickly than the large muscle groups used in the power grip. When a number of these undesirable work actions are combined in one repetitive work task, there is a substantial increase in the risk of injury to the worker.

Worker Characteristics

The most important personal characteristics that relate to repetitive strain injury are assignment to a new work task and the return to work after a period of absence. For new and returning employees, an initial reduction in the work pace or of the total time spent on the job allows the worker to develop specific fitness for the work task.

The different body sizes and physical characteristics of individuals within a work force can influence the physical demands of the job for a given worker. Employees often develop unique work postures and techniques to accommodate their own body dimensions and physical abilities. Although female workers have a higher reported incidence of repetitive strain injuries, there is no conclusive evidence that female employees are more susceptible to this type of injury than male workers.[3] Rather, the injury statistics may reflect the fact that the majority of repetitive work tasks are performed by female workers.

Treatment

The degree of success of medical treatment for the various types of repetitive strain injuries is unimpressive and, in some cases, depressingly poor.[4] For this reason, the primary emphasis must be on injury prevention. Effective treatment of this type of injury depends on early detection and the immediate resting of the affected

muscles, tendons and associated structures of the hand, arm, shoulder and neck.

Taping or splints are often used to limit movement at the injured joint and temporarily allow an injured worker to continue on the job. Taping/splints can help by limiting undesirable movements, but they can also worsen the condition if blood flow to the hand is restricted.

Exercise programs combined with rest breaks have been shown to be beneficial in some repetitive work settings.[5] Recent research also indicates that large doses of vitamins may be useful in the treatment of some repetitive strain injuries.[6] Workers should not continue to work if they are experiencing pain. If painkillers are used so that the injured worker can continue on the job, any existing or developing condition will almost inevitably worsen.

Prevention

Repetitive strain injuries can be prevented. Prevention must centre on the careful analysis of task design, workplace design, equipment and tool design, rate of work and work practices. Although this focus may not completely eliminate repetitive strain injuries, the incidence and severity of injury can be greatly reduced.

1. Task Design

To prevent repetitive strain injury, muscles should not be used repetitively in a forceful manner, at a mechanical disadvantage or at the limits of their range of motion. The appropriate design of work tasks is one way to ensure that these work actions do not occur.

To prevent RSI to the hand, wrist and forearm, the following repetitive actions should be avoided:

- Wrist extension
- Rotation of the forearm combined with deviation of the hand
- Finger extension
- Flexion of the finger, thumb or wrist

The major repetitive action associated with lateral epicondylitis or 'tennis elbow' is the lifting of objects with the hand in the grasp position and the forearm extended.

Repetitive movements that require the worker to lift one or both arms away from the chest can result in injury to the upper arm, shoulder or neck. To maintain these types of body postures, the muscles of the neck, shoulder and upper arm must be in a constant state of

contraction. The resulting static muscle contractions are very physically demanding. Therefore, these types of work postures should be avoided.

Task design should take advantage of gravity and, where possible, use mechanical techniques to optimize biomechanical leverage and reduce the force requirement of the job. Good task design incorporates features of workplace, equipment and tool design to provide the optimal fit of the work task to the physical characteristics of the worker.

2. Workplace Design

The design of a workplace greatly influences worker health, safety and productivity. Good workplace design includes the provision of appropriate seating, work benches and task lighting. If a worker remains at one work station, then this workspace should be adjusted to suit the physical characteristics of this individual. Further minor alterations can then be made by the worker. In situations where a number of workers use one work station, the workspace should be easily adjustable to accommodate a wide range of body sizes.

Workplace design and layout that accommodate the physical dimensions of an individual worker can eliminate many of the movements and postures that contribute to repetitive strain injury. The body posture required for a work task determines the static muscle stress placed on the worker. To relieve the accumulated muscle fatigue resulting from static postures, many workplace designs allow the worker to alternate between a standing and a seated position. A good seat provides sufficient support to allow the worker to relax the muscles not used for the work task and thus reduces postural fatigue. In order to achieve the correct seated posture for workers of different body sizes, all seating should be fully adjustable. The seat should be upholstered to increase the load bearing area and eliminate pressure points. Thick cushioned floor mats have been found to reduce the leg fatigue resulting from a standing work position.[7]

The height of the seat should be adjusted to position the worker at a height compatible with the work surface and the type of task being performed. The horizontal location of the chair should allow the worker's upper body to remain in a relaxed upright posture while performing the work task. The further the horizontal distance of reach, the greater the muscular exertion and the greater the risk of back injury. To provide the

needed support for the lower spine, the backrest height should be adjustable to allow contact with the lumbar curve of the back. If there is significant arm and shoulder movement required for the task, the backrest should be kept small to avoid interference with the work actions. The backrest angle should be adjustable so that the worker receives maximum support when performing the work task. The worker should sit with the thighs horizontal to avoid pressure points on the backs of the legs. Both feet should be fully supported and where footrests are required, they should be large enough to support the entire surface of the foot and allow for changes in foot position. All employees should be taught how to adjust the available seating to obtain the correct seated posture.

Work surface height is another important design element. There should be adequate thigh clearance under the work bench to allow the seated worker to sit as close as possible to the job. If the worker sits or stands back from the work task with the arms extended forward, the static effort required to maintain this posture and the decreased biomechanical advantage combine to make the job more physically demanding. For most jobs, the correct height of the work surface places the work task at or just below elbow height (with the trunk erect and shoulders relaxed). When the work bench is too low, the arms must be extended forward and away from the body. If the work bench is too high, static muscle effort is required to lift the arms up and away from the body. The edge of a high work surface can also compress the lower surface of the forearms. The ideal work bench height allows the elbows to be kept low and close to the body. This position is also optimal for the biomechanical application of forces. Work tasks requiring close visual inspection or precise fine motor adjustments should be placed above elbow height. Armrests are often used to support the forearms in a functional position for fine motor work. Compression of the forearms can be avoided by padding the front edge of a higher work surface. Jobs involving the lifting of heavy components should be positioned at or below waist height to allow the leg muscles to assist in the lift. If a work surface is used for various tasks or by different individuals, it is preferable for it to be height adjustable.

3. Equipment, Machinery and Tool Design

Proper ergonomic design of equipment, machinery and tools can prevent repetitive strain injury. Horizontal

and vertical distances, and control and hand grip dimensions should be designed to accommodate the wide range of body sizes in the work force. Traditionally, equipment and tools have been designed for the 'average' North American male and are therefore unsuitable for the majority of the modern work force. For example, women and oriental populations are generally lighter and smaller than the North American male population and their physical characteristics differ from those of the average male. Therefore, they are forced to adopt undesirable postures and work movements. Consequently, the design standards must be expanded to include the wide range of ethnic and sex differences in body size.

Equipment and machinery controls should be designed to minimize strain on the operator's muscles and tendons. Single-finger push-button controls concentrate the strain in one spot, and frequent repetition of this action can result in repetitive strain injury. Controls with a large surface area allow the worker to activate the control with different parts of the hand or body and thereby distribute the work load over a number of different muscle groups. This variation in work movements helps ensure that the load on each specific area does not exceed the threshold level for injury. The worker should be able to adjust the position of foot pedals and knee controls to allow a change in work posture. For standing operators, foot pedals that force the worker to put all their weight on one foot should be replaced by other types of controls. All controls should be usable by both left-handed and right-handed workers.

Tool and equipment design should not require the worker to move joints repeatedly to the extremes of their range of motion. Reorienting a task or redesigning a tool handle is more efficient than bending and rotating the worker's wrist. Conventional pliers, for example, force the user to bend the wrist in the direction of the little finger. Pliers with a bent-handle design, however, allow the user to keep the wrist in a neutral work position.

Considerations in hand tool design include weight; balance; grip size, shape and span; trigger pressure; and vibration. The tool should be light enough to hold easily with one hand or it should be supported with a suspension system or harness. Proper balance of the tool eliminates unnecessary static muscle effort when holding the tool. The grip dimensions should accommodate the hand sizes of the worker population and, where possible, a number of different grip sizes should

be available. As women have a smaller grip and hand span than the male population, the tools designed for men may not be suitable for female workers. The tool grip and activating controls should be within a comfortable hand span. A power grip switch or bar is preferable to a single-finger trigger. Tool activation forces should be kept to a minimum. Handles should be designed to allow the worker's wrist to remain in a neutral position when using the tool. Finger grooves, short handles and other potential pressure points or sharp edges must be eliminated as they can bruise tissue and restrict circulation in the hand. A textured grip helps minimize the force required to hold the tool. Cushioning the handle surface with foam or rubber smooths out potential pressure points and provides some thermal, electrical and vibratory insulation. The use of rubber or foam sleeves on handles of small tools can eliminate pressure points and make the tools easier to hold on to. Vibration damping or absorbing tool mounts may be required to avoid the increased risk of injury associated with hand and arm vibrations below 1,000 Hz.

A regular maintenance program ensures that the effectiveness of tools and machinery does not deteriorate. The operating force of a tool or machine can be significantly increased by accumulated dirt, insufficient lubrication, worn parts or inadequate spring loading. Poor quality control of work materials or components can also increase the physical demands of the job. Any additional work load may increase the risk of injury to the worker.

4. Personal Protective Equipment

Personal protective equipment can influence the physical demands of a repetitive work task. Hand and finger protection, thermal clothing, safety footwear, etc. must be available in a number of sizes to accommodate the physical dimensions of the workers. This is essential to ensure both a comfortable fit and optimal functional capability. For example, a worker outfitted with gloves that are too tight is likely to have restricted muscle and tendon movements in the hands. The gloves can cause the worker to exert more muscular force than is demanded by the situation and this will result in an increased risk of injury. At the other extreme, clothing that is too loose may require the worker repeatedly to readjust it and thereby introduce unnecessary hand and arm movement.

Protective equipment can also have implications for the design of the work task, workplace, and equipment and tools. For example, the type of glove used for manipulating a small component can either increase or decrease the amount of muscle force that must be used for the work task. Therefore, it is important to select a glove that suits the task in terms of fit, frictional characteristics of the contact surfaces and dexterity requirements. When designing the work station it is important to consider the effects of protective equipment on the body size of the worker. The placement of the work task should allow for the increased vertical dimension of a worker wearing safety footwear as well as the decreased horizontal arm reach resulting from wearing bulky garments. When designing equipment that is to be used in a cold work environment, the size of the controls should be increased to accommodate the size of the operator's glove.

5. Rate of Work

Proper task, workplace and equipment design cannot totally eliminate repetitive strain injuries. The rate of work is also highly correlated with the risk of injury to the worker. The appropriate rate of repetition depends on the nature of the work actions, the muscles used and the force exerted. When the work rate exceeds this level there is a dramatic increase in both the incidence and severity of injury. Piecework and other rate incentive schemes can significantly increase the rate of work and are specifically linked to repetitive strain injuries.[7] Line speeds and work rates should be set to prevent repetitive strain injuries.

6. Work Practices

Job Rotation

Jobs involving the continuous repetition of a small number of work movements often result in repetitive strain injuries. The nature of the work task increases the risk of injury by concentrating the stress and fatigue on a relatively small number of muscles. Job rotation is one method of reducing the risk of injury by limiting the duration of each worker's exposure to a specific repetitive task. Each worker rotates between work tasks that use different muscle groups and work actions. This distributes the total work load over a number of muscle groups and provides a cycle of rest

and work for specific muscles and tendons. Job rotation can effectively keep each worker's exposure to a specific work task below the threshold level for repetitive strain injury.

Rest and Exercise Breaks

Rest or exercise breaks are a useful method of relieving the accumulated fatigue associated with repetitive work.[8] Jobs involving intense concentration should have regular breaks scheduled to allow for a change in static work postures. The type of break, frequency and duration depend on the nature of the work task. For example, rest breaks are often combined with physically strenuous jobs in order to provide a change in posture to allow the muscles to relax and breathing and heart rate to return to resting levels. Exercise breaks should include gentle stretching and flexibility exercises that relax the muscles used in the work task while increasing overall blood circulation.

Periods of Adjustment

Unaccustomed repetitive work is known to be an important predisposing factor for the development of repetitive strain injury. New employees or workers returning after a period of absence (layoff, illness or vacation) should be allowed to accommodate slowly to the normal rate of work. After a four or five-day period, the worker can achieve a higher level of production without an increased risk of injury. While this practice may produce some level of inconvenience for the employer, the overall benefits are considerable.

Training

New employees and employees resuming work after an injury should receive specific instruction in work methods and be introduced gradually to repetitive work tasks. All workers and their supervisors should be instructed in the symptoms, causes and prevention of repetitive strain injury. The importance of adjusting the work station and chair and maintaining the hand and wrist in a neutral position should be reinforced. The resulting increase in awareness will encourage the early reporting of symptoms and the identification of work tasks requiring modification. This, in turn, will provide management with the opportunity to identify and prevent repetitive strain injuries.

Reporting Injuries

The early reporting of muscle pain and weakness is essential if more serious injuries are to be prevented. Detailed documentation of all injuries is an essential part of any effort to prevent repetitive strain injuries. When injury data are analysed, high risk situations can often be identified. Injury reports should record the age, height and handedness of the worker involved, along with his or her classification, length of employment and recent absences due to illness, layoff or vacation. The work shift, time of the incident and time since the last work break should also be noted. Information about the work task should include specific details of work movements used and any unique workplace or task features involved. Details related to the quality control of components or tool and equipment maintenance may also be useful in identifying a focus for injury prevention.

Résumé

Les blessures résultant d'efforts répétitifs représentent une part significative et croissante du coût d'indemnisation des travailleurs industriels. Cet article décrit avec précision les éléments qui, dans les tâches répétitives, contribuent aux risques de blessures. Les techniques de prévention sont analysées aux rubriques : conception des tâches, conception du lieu de travail, conception de l'équipement, des machines et des outils, cadence de travail et techniques de travail. En prêtant davantage attention à ces éléments dans les travaux répétitifs on pourrait réduire sensiblement la fréquence et la gravité des blessures.

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Dealing with Alcohol and Drug Abuse Within the Workplace

Summary

Alcohol and drug abuse in Canada costs over $1.2 billion in reduced productivity and $1.4 billion in social welfare. Early attention needs to be given to workers who require help before serious problems occur. This paper draws attention to the requirements of the safety regulations under the Act for workers to conduct themselves in a safe manner and details the advice given to companies by medical and nurse consultants of the ministry. The Addiction Research Foundation contact persons and the addiction/referral services available to assist employee assistance programs are listed.

Key Words: drugs, alcohol, drug testing, employee assistance programs.

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In Ontario more than 80 per cent of the population consume alcohol and about 10 per cent use it daily.* During 1982 it was estimated that alcohol and drug abuse in Canada cost $1.2 billion in reduced productivity and $1.4 billion in social welfare.†

Early attention should be paid to workers who require help with alcohol or drug abuse before serious problems occur. Timely help will allow the addiction to be handled primarily as an illness. The first actions taken can include referral to treatment and rehabilitation rather than punishment or dismissal.

Currently, recognition of substance abuse problems focuses on behavioural changes such as mood alterations, withdrawal from the social group, unexplained lateness, and so on. With appropriate counselling and direction from management and trained professionals, the affected worker can be referred to appropriate specialists for help before performance ever becomes a problem. When poor performance is manifested as lost productivity and absenteeism, the employer is in a position to confront a worker's denials of a problem. To motivate the worker to seek help, management can indicate the extent to which performance problems will be tolerated. If appropriate action is taken early, the affected worker can return to normal function within a remarkably short period of time.

Concerns over health and safety have led to a desire by many to adopt various mandatory drug-testing policies within the workplace. Those in favour argue that such testing, when done properly, is accurate and useful in prevention and dealing with substance abuse. They believe testing can be done in a manner acceptable to both labour and management. Those opposed argue that testing is inaccurate, only measures usage and not impairment and can confuse prescription drugs with illegal ones. They see testing as an insult to the dignity of workers, presuming guilt over innocence.

The Canadian Bar Association-Ontario, in the *Report on Mandatory Drug Testing* (1987), states that the

*Hon. Jake Epp, Minister of Health and Welfare Canada, 1988.
†Addiction Research Foundation.

disadvantages of mandatory testing far outweigh the advantages. The association recommends legislation both to prohibit drug testing in Canadian workplaces and to develop preventive, educational and rehabilitation programs to deal with employment-related substance abuse.

The Occupational Medical Association of Canada's (OMAC) policy (1987) regarding drug testing in the workplace is presently being appraised by the Canadian Medical Association (Appendix 1). It offers suggested guidelines to physicians. However, some reservations about testing are stated as follows:

- Testing should not be routine. It should be undertaken only where there is an actual and definable risk to workers or public health and safety due to substance abuse.
- When testing is deemed by all concerned to be justifiable, such testing is in line with the concept of working with both labour and management representatives to ensure that the rights, dignity and confidentiality of workers are respected.

Under the *Occupational Health and Safety Act* the Industrial, Construction and Mining Regulations each indicate that workers are to conduct themselves in a safe manner. Supervisors are to ensure that workers are both able to, and do, conduct themselves accordingly. The Mining Regulation explicitly addresses the issue of alcohol and drugs within the workplace:

> 14(1) No person under the influence of, or carrying, intoxicating liquor, shall enter or knowingly be permitted to enter a mine or mining plant.
>
> 14(2) Subject to subsection (3), no person under the influence of, or carrying, a drug or narcotic substance shall enter or knowingly be permitted to enter a mine or mining plant.
>
> 14(3) A person required to use a prescription drug and able to perform his work may enter a mine or mining plant upon establishing medical proof thereof.

Aside from enforcing health and safety regulations, the ministry can offer advice to companies regarding alcohol and drug abuse. When appropriate, the following advice and information is given to companies by Health and Safety Support Services Branch medical and nurse consultants.

Advice to Management and the Joint Health and Safety Committee

1. Management and the joint health and safety committee should view alcohol and drug abuse as a medical problem to be assessed by medical staff.

2. Management and the joint health and safety committee should follow policies developed jointly in responding to situations concerning worker substance abuse. These policies should address:
   - acute intoxication management;
   - chronic intoxication management; and
   - the introduction of comprehensive programs (e.g. employee assistance programs, stress management programs) to help avoid problems of substance abuse.

The following may be suggested for inclusion in the policies to be developed.

a) Acute Intoxication Management
   - Any action by the management should be based on their observation of the worker's performance or behaviour and their determination of whether the worker is unfit or unsafe for work.
   - The worker should be informed whether he or she is unfit or unsafe for work.
   - The worker should be advised to seek medical attention.
   - Management should make arrangements for the worker to be transported from the plant safely.
   - In instances where a worker appears to be under the influence of alcohol or drugs and refuses to leave the workplace, the employer should contact the local police.

b) Chronic Intoxication Management
   - Frequently, the effects of substance abuse, including poor work performance, are incremental and gradual. As soon as managers notice a problem, they should indicate their concern to the worker, require improved performance within a specified time frame and offer assistance to do this.

     Management should carefully document the performance problems, particularly as they relate to safety and productivity, and the actions they have taken. This will enable them to require that the worker deal with the problem or be subjected to progressive disciplinary action.

c) Instituting Comprehensive Programs
   - Programs to help avert substance abuse and other

health, safety and performance problems (e.g. ergonomic and stress programs) should be instituted. All workplace parties, including management, labour and occupational health professionals, have important roles to play in ensuring the success of these programs.
- Labour needs to show clear support for any program.
- Managers' and workers' representatives need to be trained to identify and document performance problems and to present the concern properly to the worker in question.
- The Addiction Research Foundation (ARF) may be contacted to help establish an employee assistance program.

Advice to the Occupational Health Professional

1. The occupational health professionals should assist management and the joint health and safety committee by recommending programs, practices and policies that may help to avoid and to deal with problems of drug abuse.

2. The occupational health professionals should establish communication with the local ARF contact person.
   The ARF provides a list of contact persons (Appendix 2) and a list of assessment/referral services (Appendix 3).* The assessment/referral services are funded by the Ministry of Health and can be used to assess workers with addiction problems and to direct them to appropriate resources for help. The professionals within these services are knowledgeable about how to negotiate an acceptable treatment with the client. They may also assist in case management, usually for a period of up to a year.

3. The occupational health professionals should be attentive to all medical problems, including substance abuse. When workers come to them for medical attention, the occupational health professional is in a position to help them identify a possible substance abuse problem and provide them counselling and/or referral, all in confidence.

*These lists were compiled prior to November, 1988. For updated lists, contact: The Employee Assistance Programs Centre, Addiction Research Foundation, 33 Russell Street, Toronto, Ontario, M5S 2S1, (416) 595-6038.

4. The occupational health professionals should refer the worker to an appropriate assessment centre for a medical assessment when alcohol or drug abuse is suspected as a reason for poor performance (unless the health professional has received training in assessments of addictions).

Medical assessments need to (a) determine the strength of the substance dependency (i.e. how dominant has the dependency become within the life of the worker) and (b) evaluate the personal strengths and weaknesses (e.g. physical, mental, family, social, etc.) of the worker concerned.

a) To evaluate the strength of the substance dependency, a number of standard tests for drug and alcohol abuse may be used. The most common tests are the Michigan Alcoholism Screening Test (MAST) and the Alcohol Dependency Scale. There are several versions of each of these tests, but they are both paper and pencil tests consisting of a number of short questions. They generally take from 10 to 20 minutes to complete.

The tests can help to establish an appropriate line of action to be taken. For example, where there is an indication of very high substance dependency (i.e. when substance abuse results in strong physical, social and emotional dependency and great costs to performance, health, family and social relations, etc.) referral to a detoxification centre may be appropriate. In cases of low substance dependency (i.e. when abuse is determined to be at the initial stages of interfering with the worker's personal life, and a good social support system is still available to the individual), some form of counselling or assistance offered to the client by a group like Alcoholics Anonymous might be appropriate.

It is important to note that the results of these tests can also play a very strong role in convincing a client that he or she does have a problem that needs to be corrected.

b) The worker should be assessed for personal strengths and weaknesses, including the ability to cope with personal problems, handle frustration and the degree of social support available to them. Sufficient information should be obtained to ensure that all possible aspects of the problem (e.g. marital, financial, etc.) are assessed and a suitable line of action is determined.

5. The occupational health professionals should advise management and the joint health and safety committee of current views regarding testing for drugs and alcohol.

Résumé

Au Canada, le coût de la toxicomanie et de l'alcoolisme sur le plan de la perte de productivité dépasse 1,2 milliard de dollars et sur celui de l'aide sociale, 1,4 milliard de dollars. On devrait aider plus tôt les employés qui en ont besoin, avant l'apparition de graves problèmes. Cet article rappelle les exigences des règlements de sécurité prévus par la loi sur la conduite securitaire des travailleurs et décrit en détail les conseils donnés aux entreprises par des experts-conseils, médicaux et infirmiers, du ministère. On y trouve également la liste des personnes-contacts de la Fondation de recherche sur la toxicomanie ainsi que des services d'orientation et de traitement de la toxicomanie, à l'appui des programme d'aide aux employés.

Acknowledgement

We would like to thank Bruce H. Cunningham, Divisional EAP Consultant, Addiction Research Foundation, for his help in preparing this document.

Appendix I

OMAC Policy on Alcohol and Drug Testing in the Workplace

The Occupational Medical Association of Canada (OMAC) issues this policy to guide Canadian occupational health physicians on the question of alcohol and drug testing in the workplace.

While recognizing the potential consequences to the safety of workers and to the general public engendered by alcohol and drug abuse, OMAC has reservations about alcohol and drug testing in the workplace. It is the association's view that:

1. Underlying Principles

1.1 Alcohol drug testing in the workplace should be undertaken only where there is an actual and definable risk to workers or public health and safety due to the use of alcohol or drugs.

1.2 Occupational health physicians should restrict their participation to circumstances where the requirements of the job dictate that it is not safe to permit any alcohol or drug impairment in the person concerned. Routine, non-job specific alcohol or drug testing has no part in occupational health and safety programs. Physi-

cians who fail to observe this distinction compromise their ability to function as objective medical advisers to employee and employer.

2. If it is deemed by all concerned that an alcohol and drug testing program is justifiable:

   2.1 The occupational health physician should participate with employee and employer representatives in the planning of the testing program. The physician's role is restricted to determining fitness-to-work and providing medical and technical advice on sampling and analysis. A reputable private laboratory should be retained to perform and report on the testing.

   2.2 The occupational health physician must be knowledgeable about the limitations of the specific analytic procedures that will be used, about the significance of all possible results to job safety and about factors that may confound the analysis or lead to false conclusions. He or she must be assured that the test results will clearly contribute to a meaningful fitness-to-work statement.

   2.3 The occupational health physician should participate in a testing program only if the workers have been informed of the reason for testing, the substances being tested for, the sampling and general analytic procedures, the disposition of test results and the consequences of positive findings.

   2.4 Alcohol and drug testing procedures endorsed by the physician should never compromise the legal rights or dignity of the workers.

   2.5 Individual test results must be kept confidential. The worker providing a sample for analysis is entitled to be informed of the result, but the employer should be given only a fitness-to-work statement without mention of diagnosis or test result.

   2.6 The diagnosis of an alcohol or drug use problem should be followed by referral for treatment and rehabilitation, preferably via an employee assistance program (EAP).

Appendix 2

Addiction Research Foundation (ARF) Contact Persons for Employee Assistance Program (EAP) Referral

Northern Ontario Region

Kenora Centre	Melissa Real-King	(807) 468-6372
North Bay Centre	Colleen Zilio/ Doug Graham	(705) 472-3850
Sault Ste Marie Centre	Colleen Zilio/ Mike O'Shea	(705) 256-2226
Sudbury Centre	Lucien Mageau/ Colleen Zilio	(705) 675-1195
Thunder Bay Centre	Bob Bishop	(807) 622-0607
Timmins Centre	Betty Findlay	(705) 267-6419

Eastern Ontario Region

Belleville Centre	Helen Connop	(613) 962-9482
Cornwall Centre	Peter Barkway	(613) 937-4035
Kingston Centre	Robert Goodfellow	(613) 546-4266
Ottawa Centre	Charlie Ponce/ Helen Youngson	(613) 722-1075
Pembroke Centre	Larry Sobol	(613) 735-1023
Perth Centre	Christine Bois	(613) 267-1152
Peterborough Centre	Brian Mitchell	(705) 748-9830

Metro Toronto Region

Durham Centre	Suzin Jackson	(416) 576-6277
Georgian Bay Centre	Gloria Romanic	(706) 726-4976
Halton Centre	Peter Marks	(416) 623-2436
Peel Centre	Frank Fallon	(416) 270-1431
Toronto EAP Centre	Wilfred Orgias	(416) 959-6028

Western Ontario Region

Chatham Centre	Dave Hart	(519) 354-1000
Hamilton Centre	Rick Csiernik	(416) 525-1250
Kitchener Centre	Pat Allen	(519) 579-1310
London Centre	Don Morgan (Dir)	(519) 433-3171
Niagara Centre	Barry Dunbar/ Stephen Boal	(416) 685-1361
Owen Sound Centre	Dave Docherty	(519) 371-1861
Simcoe Centre	Toby Barrett	(519) 426-7260
Windsor Centre	Harry Hodgson	(519) 253-1146
Sarnia Centre	Angie Chiu	(519) 337-9611

Clinical Institute – Toronto

Emergency Department (24 hours)	(416) 595-6128
Intake Co-ordinator	(416) 595-6021
Program for the Employed	(416) 595-6027

Appendix 3

Addiction Research Foundation Centres

Eastern Ontario Region		Assessment/Referral Services
Belleville Centre, 248 Bridge Street E., Belleville, Ontario, K8N 1P1. (613) 962-9482	Incorporated	Addiction Training and Assessment Counselling Incorporated (ATAC), 218 Front Street, Belleville, Ontario, K8N 2Z2. (613) 962-5860
Cornwall Centre, 132 Second Street E., Suite 406, Cornwall, Ontario, K6H 1Y4. (613) 937-4035/4036	Sponsored	Drug Addiction Program, Eastern Ontario Health Unit, 1000 Pitt Street, Cornwall, Ontario, K6J 3S5. (613) 933-1375 Ext. 233 (800) 267-7120
Kingston Centre, 309 Alfred Street, Kingston, Ontario, K7L 3S4. (613) 546-4266	Incorporated	Kingston Alcohol Referral Centre Inc., 131 Johnson Street, Kingston, Ontario, K7L 1X9. (413) 546-1758
	Sponsored	North Frontenac Community Services, Elizabeth Street, P.O. Box 250, Sharbot Lake, Ontario, K0H 2P0. (613) 279-2928
	Sponsored	Lennox & Addington County Addictions, Assessment/Referral Service. a) Napanee Assessment/Referral, c/o Lennox and Addington County General Hospital, 8 Park Drive, Napanee, Ontario, K7R 2Z4. (613) 354-3301 Ext. 228

Eastern Ontario Region (*cont.*)		Assessment/Referral Services
		b) Land O'Lakes Community Services, P.O. Box 92, Northbrook, Ontario, K0H 2G0. (613) 336-8936
Ottawa/Carleton Centre, 383 Parkdale Avenue, Suite 304, Ottawa, Ontario K1Y 4R4. (613) 722-1075	Sponsored	Addictions Assessment/ Referral Service, Sandy Hill Health Centre, 250 Somerset Street E., Ottawa, Ontario, K1N 6V6. (613) 563-2314
Pembroke Centre, 77 Mary Street, Suite 201, Pembroke, Ontario, K8A 5V4. (613) 735-1023	Sponsored	Renfrew County Alcohol and Drug Assessment Referral Service. a) c/o Renfrew Victoria Hospital, 499 Raglan Street N., Renfrew, Ontario, K7V 1R9. (6130 432-4851 Ext. 184, 186 b) Pembroke Centre, 77 Mary Street, Suite 201, Pembroke, Ontario, K8A 5V4. (613) 732-3356 c) Barry's Bay Centre, c/o Renfrew Victoria Hospital, 499 Raglan Street N., Renfrew, Ontario, K7V 1R9. (613) 756-3044 d) Deep River Centre, c/o Renfrew Victoria Hospital, 499 Raglan Street N., Renfrew, Ontario, K7V 1R9. (613) 584-3358

Eastern Ontario Region (*cont.*)		Assessment/Referral Services
Perth Centre, 45 Drummond Street, Perth, Ontario, K7H 2J9. (613) 267-1152	Sponsored	Brockville Addiction Assessment Centre, c/o Brockville General Hospital, 82 Emma Street, Brockville, Ontario, K6V 1S9. (613) 345-5645 Ext. 163
	Sponsored	Lanark, Leeds, Grenville Addictions Assessment Referral and Case Management Service, 45 Drummond Street, Perth, Ontario, K7H 2J9. (613) 267-1152
Peterborough Centre, 223 Aylmer Street N., Suite 07, Peterborough, Ontario, K9J 3K3. (705) 748-9830	Incorporated	Fourcast Assessment and Referral Service Incorporated, 332 Aylmer Street N., Peterborough, Ontario, K9H 3V6. (705) 876-1292

Metro Toronto Region		Assessment/Referral Services
Durham Centre, 44 Bond Street W., 10th Floor, Oshawa, Ontario, L1G 1A4. (416) 576-6277		
Georgian Bay Centre, 100 Bell Farm Road, Barrie, Ontario, L4M 4Y5. (705) 726-4976	Incorporated	Simcoe Outreach Services, A Centre for Addictions, 30 Bayfield Street, Barrie, Ontario, L4M 3A5. (705) 726-7062
	Incorporated	Addiction Services for York Region, 471 D'Arcy Street, Newmarket, Ontario, L3Y 1M9. (416) 898-5950

Metro Toronto Region (*cont.*)		Assessment/Referral Services
Halton Centre, 3425 Harvester Road, Suite 211, Burlington, Ontario, L7N 3N1. (416) 632-2436	Incorporated	Alcohol and Drug Addiction Program (ADAT), 760 Brant Street, Suite 407, Burlington, Ontario, L7R 4B7. (416) 639-6537
Peel Centre, 1270 Central Parkway W., Suite 302, Mississauga, Ontario, L5C 4P4. (416) 270-1431	Sponsored	Alcohol & Drug Assessment Program, 180 Sandalwood Parkway E., Brampton, Ontario, L6Z 1Y5. (416) 840-1440 Ext. 216
Metro Toronto Centre, 175 College Street, Toronto, Ontario, M5T 1P8. (416) 595-6028		

Western Ontario Region		Assessment/Referral Services
Chatham/Sarnia Centre, 575 Queen Street, Chatham, Ontario, N7M 2J7. (519) 354-1000	Sponsored	Kent County Addiction Program, Chatham Public General Hospital, 106 Emma Street, Chatham, Ontario, N7L 1A8. (519) 436-2599
Chatham/Sarnia Centre, 265 North Front Street, Suite 106, (The Petrosar Building), Sarnia, Ontario, N7T 5S6. (519) 337-9611	Sponsored	Addiction Unit, Health Services Building, Sarnia General Hospital, 209 Essex Street, Sarnia, Ontario, N7T 6H6. (519) 344-3661 Ext 5370
Hamilton Centre, 20 Hughson Street S., Suite 508, Hamilton, Ontario, L8N 2A1. (416) 525-1250	Sponsored	Alcohol and Drug Assessment Services, 21 Hunter Street E., 3rd Floor, Hamilton, Ontario, L8N 1M2. (416) 521-4811

Western Ontario Region (*cont.*)		Assessment/Referral Services
Kitchener Centre, 639 King Street W., Kitchener, Ontario, N2G 1C7. (519) 579-1310	Sponsored	Waterloo Region Alcohol and Drug Assessment Service, 637 King Street W., Kitchener, Ontario, N2G 1C7. (519) 579-3350
	Sponsored	Alcohol & Drug Assessment & Information Centre, 151 Delhi Street, Guelph, Ontario, N1E 4J3. (519) 836-5733
London Centre, 414 Dufferin Avenue, London, Ontario, N6B 1Z6. (519) 433-3171	Incorporated	Thames Valley Addiction Assessment/Referral Centre, 414 Dufferin Avenue, London, Ontario, N6B 1Z6. (519) 673-3242
	Sponsored	Huron County Addiction Assessment & Referral Centre, Huroview Building, P.O. Box 1120, Clinton, Ontario, N0M 1L0. (519) 482-3416 1-800-265-5184
	Sponsored	Perth Addiction Assessment Centre, 380 Hibernia Street, Stratford, Ontario, N5A 5W4. (519) 271-6730
Niagara Centre, 63 Church Street, Suite 410, St. Catharines, Ontario, L2R 3C4. (416) 685-1361	Incorporated	Niagara Alcohol & Drug Assessment Service, 20 Lake Street, 2nd Floor, St. Catharines, Ontario, L2R 5W7. (416) 684-1183

Western Ontario Region (*cont.*)		Assessment/Referral Services
Owen Sound Centre, County Building, 595 9th Avenue E., Owen Sound, Ontario, N4K 3E2. (519) 371-1861	Sponsored	Grey Bruce Alcohol Assessment and Referral Service, 930 2nd Avenue E., Suite 1, Owen Sound, Ontario, N4K 2H6. (519) 371-1232 1-800-265-3133
Simcoe Centre, 191 Queensway West, Suite 1, Simcoe, Ontario, N3Y 2M8. (519) 426-7260	Sponsored	Alcohol and Drug Abuse Assessment & Referral Program, 225 St. Paul Avenue, 6th Floor, Brantford, Ontario, N3R 5Z3. (519) 753-7377 Ext. 322, 324, 325
	Sponsored	Haldimand-Norfolk Regional Health Department, Addiction Assessment and Referral Service, P.O. Box 247, 365 West Street, Simcoe, Ontario, N3Y 4L1. (519) 426-6170
Windsor Centre, 2090 Wyandotte Street E., Windsor, Ontario, N8Y 1E6. (519) 253-1146	Sponsored	Leamington and South Essex Alcohol and Drug Assessment Service, Leamington District Memorial Hospital, 194 Talbot Street W., Leamington, Ontario, N8H 1N9. (519) 322-2501

Northern Ontario Region		Assessment/Referral Services
Kenora Centre, 101 Chipman Street, Kenora, Ontario, (807) 468-6372	Sponsored	Alcohol & Drug Assessment/Referral Primary Care & Counselling, c/o St. Joseph Health Centre, 21 Wolsley, Kenora, Ontario, P9N 3W7. (807) 468-6099
	Sponsored	Red Lake/Ear Falls Alcohol Assessment/ Referral Counselling Service, Margaret Cochenour Memorial Hospital, P.O. Box 314 Red Lake, Ontario, P0V 2M0. (807) 727-3128
	Sponsored	Sioux Lookout Community Counselling Program, P.O. Box 506, Sioux Lookout General Hospital, Sioux Lookout, Ontario, P0V 2T0. (807) 737-1588
	Sponsored	Community Counselling Services, Dryden District General Hospital, P.O. Box 3003, Dryden, Ontario, P8N 1V8. (807) 223-5261 Ext. 212
	Sponsored	Community Counselling Services, Atikokan General Hospital, 120–130 Dorothy Street, Atikokan, Ontario, P0T 1C0. (807) 597-2744

Northern Ontario Region (*cont.*)		Assessment/Referral Services
North Bay Centre, 288 Worthington Street W., North Bay, Ontario, P2B 3B4. (705) 472-3850	Sponsored	Alcohol & Drug Assessment Program (ADAP), c/o Family Life Centre, 269 Main Street W., Suite 305, North Bay, Ontario, P1B 2T8. (705) 472-6515
Saulte Ste. Marie Centre, 464 Albert Street E., Walrus 11, Sault Ste. Marie, Ontario, P6A 2J8. (705) 256-2226		
Sudbury Centre, 144 Pine Street, Suite 203, Sudbury, Ontario, P3C 1X3. (705) 675-1195	Sponsored	Addiction Services, Sudbury Algoma Hospital, 680 Kirkwood Drive, Sudbury, Ontario, P3E 1X3. (705) 675-7022
Timmins Centre, 119 Pine Street S., Suite 324, Timmins, Ontario, P4N 2K3. (705) 267-6419	Incorporated	North Cochrane Addiction Services, Service de Toxicomanie Inc., Cochrane Nord, 19B Riverside Drive, Kapuskasing, Ontario, P5N 1A4. (705) 335-8408
	Incorporated	South Cochrane Addiction Services, 85 Pine Street S., Suite 204, Timmins, Ontario, P4N 2K1. (705) 264-5202
	Sponsored	Temiskaming Alcohol Assessment Program, c/o Temiskaming Health Unit.

Northern Ontario Region (*cont.*)

Assessment/Referral Services

a) 221 Whitewood
Avenue,
New Liskeard,
Ontario,
P0J 1P0.
(705) 647-4305

b) 6 Tweedsmuir Road,
Kirkland Lake,
Ontario,
P2N 1H9.
(705) 567-9355

Thunder Bay Centre,
1265 Arthur Street E.,
West Arthur Place,
Suite 104,
Thunder Bay, Ontario,
P7C 4X8.
(807) 622-0607

Book Review

Psychiatric Injury in the Workplace Occupational Medicine: State of the Art Reviews

Robert C. Larsen, M.D., M.P.H. and Jean S. Felton, M.D., Eds.

Hanley and Belfus, Inc., 1988.

This publication consists of 12 articles from *Occupational Medicine* (Volume 3, Number 4, 1988), each focusing on current issues relative to psychiatric injury within the workplace. The contributors represent the fields of occupational medicine, psychiatry, psychology and the social sciences. It is intended as a supplement to an earlier 1986 *Occupational Medicine* monograph, 'The Troubled Employee', which discusses violence in the workplace, substance abuse and managing disturbed employees and which also reviews other issues of mental health in the workplace.

Psychiatric Injury in the Workplace has a wide audience, including psychiatrists, occupational medicine specialists, employee assistance personnel, employer representatives, insurance/benefits professionals, health policy makers, research scientists and academics.

The articles address very timely and complex issues respecting stress, injury and dysfunction, especially as they pertain to compensation. Several of the articles also offer general steps for assessing and dealing with problems. For example, Dr. M.E. Mor-Barak deals with various ways by which management and mental health professionals can use research findings on social support to help employees and organizations cope with problems. Dr. A.J. Enelow reports on a system of guidelines for the description of permanent partial psychiatric disability, using eight areas of work functioning. Drs. S.G. White and C. Hatcher describe a means of offering help to workers who have experienced violence within the workplace. Dr. B. Lawton summarizes the preventive measures that EAPs can effect while illustrating the specific methods used by his firm.

Other issues covered in this publication include occupational stress, mass psychogenic illness, the role of the occupational physician and ethical issues. There are also overviews of relevant U.S. state laws and compensation rulings, such as those pertaining to repetitive and cumulative injury, stress and causation of psychiatric injury.

The articles are well written and offer useful information relevant to the workplace. However, the article

by Dr. E.S. Morgenthaler on psychological testing is very general and could be more directed at questions specific to testing related to the workplace. Also, a number of the articles address the same topics and review the same case histories (e.g. causation, cumulative injury and the law) from different perspectives. This causes the reader some confusion as fairly precise and, often, legalistic language is involved, and slight differences in wording are quite meaningful. The goals of some of these 'overlapping' articles are not clearly stated and this adds to the reader's difficulties in formulating a coherent overview of the issues. A more detailed preface to the text addressing these issues and/or better collaboration between authors would have helped with this problem.

In summary, this publication is a good resource for a range of people who have an interest in occupational health and/or good management practices. It updates the reader on scientific and legal thought as it relates to psychiatric injury in the workplace and offers good insight into how problems are assessed and dealt with by various professions. As the book comprises several independent articles, there are some topics for which the reader is required to compare and contrast different reviews of the same topic to obtain a coherent overview. Nevertheless, here is a rich source of fascinating information on psychiatric injury within the workplace.

Gerald Goldberg

Recent Publications Available From the Government Book Store

Regulations

Workplace Hazardous Materials Information System – made under the Occupational Health and Safety Act Ontario Regulation 644/88

Hazardous Materials Inventories – made under the Occupational Health and Safety Act Ontario Regulation 643/88

News and Notes

BULLETIN!

Occupational Health and Safety Reform 1989

Fundamental reform of the *Occupational Health and Safety Act* has been tabled by the government in the Legislative Assembly of Ontario.

A full explanation of these changes and the directions in which they are leading is contained in a booklet entitled *Occupational Health and Safety Reform 1989*. It is available, on request, from:

Communications Branch,
Ontario Ministry of Labour,
15th Floor,
400 University Avenue,
Toronto, Ontario
M7A 1T7.
(416) 965-7941

Physical Agent Fact Sheets

The following fact sheets have been developed by the Radiation Protection Service, Health and Safety Support Services Branch, Ministry of Labour, to assist workers in Ontario to understand better the health hazards associated with the use of X-ray, laser, ultraviolet, microwave and radiofrequency radiation. The basic preventive measures and the first aid measures are described and the exposure limits are referenced.

X-Ray

Hazard

X-rays are a penetrating form of ionizing radiation from sources such as human and animal diagnostic X-ray machines, industrial radiography units and diffraction analysis units. X-rays may cause significant and irreversible health effects to workers and their offspring depending on the X-ray dose received.

Description

X-rays are a form of electromagnetic radiation in the energy range above 5,000 electron volts. The most

common X-ray source is an electrically powered machine containing an X-ray tube.

The measurement of X-ray levels is made by a hand-held survey meter, which may read in the SI radiological unit, Grays per hour (a measure of air kerma, i.e. the intensity of the X-ray field at some point), or in the older unit, Roentgens per hour (a measure of exposure). Survey meters are used to monitor the level of X-rays near an X-ray source during surveys.

The measurement of the accumulated X-rays received by a person is normally made by a personal dosimeter worn on the clothing outside any personal shielding. Personal dosimeters may read in the SI radiological unit, Sieverts, or in the older unit, Rems (measures of dose equivalent).

Personal dosimeters make it possible to establish the individual dose equivalent received by each worker on the job. That dose is monitored and compared with the limits in the Regulation Respecting X-Ray Safety, which are based on the health effects of X-ray radiation.

X-ray workers are workers who may be exposed to X-rays as a necessary part of their employment and who are permitted to receive a greater dose than that for all other workers. The exposure of X-ray workers must be continuously monitored by personal dosimeters.

Health Effects

Intense over-exposure to X-rays can cause severe and immediate (i.e. beginning within a few hours or days) symptoms, such as burns and blisters, radiation sickness and death.

Less intense over-exposure to X-rays may lead to an increased risk of long-term health effects, e.g. cancers, genetic damage, cataracts, temporary sterility and reduced white blood cell count.

Of special concern is the exposure of pregnant workers to X-rays, especially in the first 16 weeks of pregnancy. The risk of developmental defects and childhood cancer may be increased.

First Aid

In order to administer the appropriate treatment for over-exposure, the dose received must be estimated from inspection data and personal dosimetry. These data must be given to the treating physician to whom the worker must be referred.

Preventive Measures

These include:

1. Plans review and acceptance by the Radiation Protection Service of the Ontario Ministry of Labour for the original installation of an X-ray source and any later changes.

2. Strict adherence to established X-ray safety operating procedures.

3. Use of personal shielding, such as lead aprons, gloves and collars, as necessary.

4. Proper use of personal dosimeters.

5. Instruction of workers in the proper use of X-ray sources.

6. Interlocks must never be defeated.

Exposure Limits

	Dose Equivalent Annual Limits (milli Sieverts)	
	X-Ray Workers	All Other Workers
Whole body or part	50	5
Lens or eye	150	50
Skin or other organ	500	50

Laser Radiation

Hazard

Exposure to laser radiation can produce eye and skin damage. The extent of the damage depends on the wavelength and intensity of the radiation and on the duration of the exposure. The only documented laser-related fatalities, however, were electrocutions by the high-voltage power supplies used to energize the lasers. Powerful lasers may also present fire and chemical hazards.

Description

A laser is a device for producing radiation that is coherent in both space and time (i.e. the waves are all in phase and have the same frequency). The radiation may be in the 'visible' (light) or 'invisible' (ultraviolet or infrared) part of the electromagnetic spectrum. As a result of the coherence of the radiation, laser beams have a large concentration of energy per unit area and very little divergence. This almost constant power density at both ends of the beam is a significant factor in the hazard potential of a laser. Lasers are classified into four groups according to their potentially hazardous capabilities:

Class 1. Cannot produce hazardous radiation.

Class 2. Continuous (>0.25 s) intrabeam exposure may damage the eye, but they are safe for momentary (<0.25 s) exposure.

Class 3. Momentary intrabeam exposure, or specular reflection, may damage the eye.

Class 4. Can damage the skin as well as the eye during momentary intrabeam exposure or exposure to specular, and even diffuse, reflection. Can ignite combustible materials.

Health Effects

Laser irradiation of the eye may cause damage to the cornea, the lens or the retina, depending on the wavelength and intensity of the radiation and the absorption characteristics of the ocular tissues. At the longest infrared wavelengths most of the radiation is absorbed by the cornea. At shorter wavelengths the cornea becomes more transparent and the point of injury shifts to the lens of the eye. In the visible and near infrared range the ocular media are quite transparent and the main hazard is retinal damage. Because of the focusing capability of the eye, retinal damage is the chief hazard from lasers operating in the visible region. For ultraviolet radiation, the ocular media becomes less transparent and the damage is concentrated at the surface of the cornea. There is also some evidence of photochemical effects on the retina caused by excessive exposure to blue light.

Acute exposure of the skin to sufficiently high amounts of energy from a laser may lead to burns that do not differ from ordinary thermal or solar burns. Chronic,

low-level exposure to laser radiation generally does not lead to injury. Exposure to laser radiation has not been found to be associated with increased incidence of cancer. It should be pointed out, however, that excessive exposure to ultraviolet radiation (whether coherent or not) can lead to skin cancer.

Preventive Measures

Since dangerous currents and voltages are commonly present in the power supplies used to energize the lasers, maintenance and repairs should be carried out only by qualified personnel.

Class 1

1. No specific control measures are necessary, although direct exposure of the eye should be avoided as a matter of good practice.

Class 2

1. The equipment should be operated only by qualified personnel.

2. Do not stare into the beam or its specular reflections; an exposure longer than 250 ms might damage the retina.

3. Terminate all laser beams in a suitable material and control the beam paths.

4. Do not defeat any interlock or safety device.

5. Do not insert objects that can produce specular reflections in the laser path.

6. Warning labels should be affixed to the equipment and to access doors.

Class 3

1. The control measures recommended for the previous classes apply.

2. No optical instruments, such as binoculars, telescopes or cameras, should be used to view the direct beam or its specular reflections.

3. The beam attenuator or shutter should be engaged, or the laser turned off when the beam is not in use.

4. Protective goggles appropriate to the wavelength(s)

emitted by the laser should be worn when beams are accessible. Goggles should have side-shields and be marked with the optical density for each laser wavelength applicable.

5. Special attention should be given to lasers emitting non-visible radiation. (Nd:YAG and CO_2 laser radiations are non-visible, yet they can damage the eye. Also, they may be specularly reflected from apparently 'dull' or 'matte' metal surfaces.)

6. The beam path should be enclosed whenever possible.

7. The laser should be used in a controlled-access area.

8. Adequate precautions should be taken to prevent hazards indirectly related to laser use, e.g. toxic gases and fumes, cooling liquids, ignition of gases or flammable materials.

Class 4

1. The control measures recommended for the previous classes apply.

2. Protective eyewear should be used for close observation of the target area.

3. Keep flammable materials away from beam paths.

4. Measures to avoid exposure to gases or fumes (generated by the interaction of the laser with the targets) should be taken.

5. Use remote firing and monitoring whenever possible.

The operation of laser light shows in Ontario should follow the 'Safe Operating Guidelines' available from the Radiation Protection Service, Ontario Ministry of Labour.

First-Aid Measures

Anyone who is suspected of having a laser-related eye injury should be examined as soon as possible by an eye-care specialist.

Laser-related skin burns should be treated as any other skin burn. Cold water or ice should be applied immediately to the area for first and second degree burns (skin reddened or blistered). For third degree burns

(open wounds), apply a sterile dressing and seek medical attention. Never put ointments, creams or butter on burns.

Exposure Limits

ACGIH 1987–88.

ANSI Z136.1 – 1986 Standard for the safe use of lasers.

IEC 825 (1984) Radiation safety of laser products, equipment classification, requirements and users guide.

WHO Environmental Health Criteria 23 – Lasers and Optical Radiation.

Ultraviolet Radiation (UV)

Hazard

Excessive exposure to UV radiation may cause detrimental health effects to the eyes and skin. The nature and severity of the injuries depend on the duration of the exposure, the intensity and wavelength of the radiation and the sensitivity of the individual.

Description

Ultraviolet radiation is electromagnetic radiation of the same nature as visible light, but of higher energy and shorter wavelength. UV radiation is located in the section of the electromagnetic spectrum that lies between visible light and X-rays. Customarily, UV radiation is divided into three wavelength regions: UV-A (315-400 nm), UV-B (280-315 nm), and UV-C (180-280 nm) (1 nm = 1 nanometre = 1 billionth of a metre, and is a unit used to measure wavelength). Ordinary window glass provides adequate protection against UV-B and UV-C radiation from moderate sources. Although UV radiation is not normally detected by the eye or the skin, most sources of UV radiation also emit visible light. Common sources of UV radiation include the sun, suntanning lamps, welding arcs, mercury discharge lamps, germicidal lamps, curing lamps and some lasers. UV radiation can be measured with radiometers over specific wavelength bands (usually in mW/cm^2).

Health Effects

Although limited exposure to UV radiation can have beneficial health effects (e.g. synthesis of Vitamin D),

excessive exposure can produce detrimental effects ranging from 'sunburn' (erythema) to skin cancer. The nature and severity of the injuries are affected by the following factors:

a) the total exposure received in a given period of time (i.e. the dose);
b) the type of UV radiation (i.e. the wavelength);
c) the reflectance and absorption characteristics of the exposed surface (which depend on skin pigmentation);
d) the sensitivity of the exposed organ (e.g. eye or skin).

The most common acute harmful effect of excessive UV exposure of the eye is kerato-conjunctivitis, an acute inflammation of the cornea and the conjunctiva. The symptoms are irritation, the feeling of foreign bodies in the eye and increased sensitivity to light. The symptoms begin to appear six to 10 hours after the exposure, and they normally disappear after a period of 24 to 48 hours. Usually, no permanent damage to the eye results, unless severe exposures have occurred. This type of injury is a common consequence of exposure of unprotected eyes to a welding arc (welder's flash). Retinal damage by UV radiation is rare because of the attenuation provided by the cornea, lens and ocular fluids. Ultraviolet radiation may, however, be a hazard for individuals who have had the lens of the eye removed, and in exposures to certain types of lasers.

Acute UV radiation damage to the skin ranges from mild reddening to painful second degree burns. Darker complexioned and/or tanned individuals are less sensitive to UV radiation exposure. It should be noted, however, that some drugs (e.g. tetracycline) can enhance skin sensitivity to UV radiation. Combined exposure to UV and to certain chemicals found in some detergents, cosmetics and coal tar distillates may result in photosensitization or photoallergic reactions. UV exposure may also stimulate the outbreak of cold sores (Herpes simplex) in some individuals. Chronic exposure of the eye to UV radiation can influence the degeneration of the ocular tissue, and, in some cases, can produce cataracts.

Chronic exposure to UV radiation from the sun and from artificial sources is a major factor in the premature aging of the skin and several types of skin cancer. Long-term protection against excessive exposure is important since the probability of developing skin cancer increases with the accumulated UV dose. Lighter-

complexioned people are more likely to develop UV-related skin cancers than darker-complexioned people.

Preventive Measures

1. UV radiation should be contained wherever possible through the use of opaque materials or attenuated by appropriate optical filtering (e.g. welding filters, glass, PVC, perspex, plexiglass).
2. Access covers or doors to high-power UV sources should be electrically or mechanically interlocked. Proper warning labels should be posted.
3. Reflective surfaces, especially polished metals, should be covered with a UV-absorbing material (e.g. vinyl, oil, flat-black paint or epoxy paint).
4. Where the radiation cannot be contained it should be confined to the smallest possible area; and the access to this area should be restricted.
5. UV sources should be used in such a manner that the radiation will be directed away from the operator and other workers.
6. Distances between UV sources and personnel should be kept to a maximum.
7. Exposure duration should be kept to a minimum.
8. Eyes should be adequately protected by means of welding filters, laser goggles, transparent UV-absorbing spectacles and clear impact-protecting eyewear, depending on the conditions of the exposure. Side shields should be incorporated in all UV eyewear.
9. The skin is adequately protected by most types of close-weave clothing. Leather, rubber, cloth, or vinyl gloves are effective in protecting the hands under most circumstances. Sunscreens and barrier creams with large protection factors (15–18) can be used to protect the skin, provided that an adequate film thickness can be maintained. A welder's helmet should provide protection for the neck as well as the eyes and face.
10. Workers with symptoms of excessive UV radiation exposure should seek advice from medical specialists.

First Aid Procedures

Eyes – Place sterile dressing over the eyes of the person presenting symptoms of UV overexposure. Seek medical advice.

Skin – Apply cold water or ice to the skin burns. Do not apply burn ointments, creams or butter. Seek medical advice.

Exposure Limits:

The following should be noted:
ACGIH – 1987 – 1988.
IRPA/INIRC – 1987 (proposed).

Eye and Face Protection

CSA standard Z94.3-M1982, Industrial Eye and Face Protectors.

ISO standard 4851, Personal eye-protectors – Ultraviolet filters – Utilization and transmittance requirements (1979).

Microwave and Radiofrequency Radiation

Hazard

Exposure to excessive microwave (MW) and radiofrequency (RF) radiation may produce detrimental health effects. The effects are primarily due to heating of the tissues that absorb the radiation. The extent of the damage depends on the intensity and wavelength of the radiation and on the duration of the exposure.

Description

Microwave and radiofrequency radiation are electromagnetic radiation of the same nature as visible light, but of lower energy and longer wavelength. The frequency range of RF/MW radiation is usually considered to be between 10 KHz and 300 GHz. The radiofrequency section of the electromagnetic spectrum is widely used for broadcasting AM and FM radio and television signals. Radiofrequency is also used in radar and for heating materials in industrial applications. Microwave radiation is widely used in communications links, medical diathermic treatments and in domestic and commercial microwave ovens.

Health Effects

Although we are constantly exposed to radiofrequency radiation from radio and TV broadcasting, no health risks have been identified as a result of this low-level exposure. Exposure to intense RF and MW fields, however, can produce an increase in tissue temperature (due to absorption of the energy carried by the electromagnetic field), which may result in burns. For microwave frequencies, the burns occur in internal tissues, primarily in the interfaces between fat and muscle and between muscle and bone. Tissues with poor temperature control, such as the lens of the eye, are at higher risk of thermal damage. Cataracts, clouding of the lens of the eye, may occur as a result of exposure to intense microwave radiation. Continuous exposure of the whole body for an extended period of time to a microwave power density in excess of 10 mW/cm^2 can cause a rise in body temperature and may produce symptoms typical of a fever.

Long-term exposure to radiation levels insufficient to cause thermal effects are suspected, by some researchers, to cause health effects ranging from insomnia and headaches to leukemia and disorders of the immune and central nervous systems. These claims, however, are controversial because the evidence is scant and, in some cases, contradictory. It is currently accepted that adverse health effects are unlikely to occur if the absorption rate of MW or RF energy is kept below 0.4 watts per kilogram (0.4 W/kg). For frequencies below about 3 MHz, RF shocks and burns may occur when touching ungrounded metal objects.

Preventive Measures

1. Radiation levels in work areas should be kept below the recommended continuous exposure limits.
2. Sources of RF/MW radiation should be properly shielded to minimize stray radiation.
3. Devices that can produce acute thermal injuries (e.g. microwave ovens, RF driers) should have interlocked doors.
4. Machines that produce high levels of RF/MW radiation should be operated remotely whenever possible.
5. Areas where radiation levels are suspected of exceeding the recommended continuous exposure limits should be surveyed to determine radiation levels.

If the levels cannot be reduced, appropriate time limits should be set to avoid overexposure.

6. All potentially hazardous devices should be appropriately labelled, and areas of excessive exposure around them, clearly demarcated. Notices with warnings and the necessary precautions should be posted.
7. Avoid installing equipment sensitive to RF/MW radiation, such as telephone switchboards, control panels, electrically-activated explosive devices and even metallic objects, near to sources of RF/MW radiation.
8. To prevent electrocutions, maintenance of devices used to produce RF/MW radiation should follow standard safety procedures and should be done with the equipment turned off, if possible.

First Aid Procedures

Apply cold water or ice to the burn area. Seek medical attention. MW or RF overexposure may produce burns in internal tissues without apparent skin injury, so a follow-up physical examination is advisable. Severe contact shocks, as well as line power shocks (60 Hz), may require hospitalization.

Exposure Limits

In Ontario the exposure limit recommended for occupational exposure of the whole body in any one-hour period is frequency dependent and varies as shown in the Table below. In addition, the equivalent power density should never exceed 25 times the corresponding tabulated value when averaged over one second.

Frequency Range	Equivalent Power Density mW/cm^2 (f in MHz)
10 kHz – 3 MHz	100
3 MHz – 30 MHz	$900/f^2$
30 MHz – 100 MHz	1
100 MHz – 1 GHz	f/100
1 GHz – 300 GHz	10

When the electric (E) and magnetic (H) fields are used to measure RF/MW radiation levels, the equivalent power density (P) can be calculated according to the following formulae,

$P = \frac{E^2}{3770}$, where [E] = [V/m], [P] = [mW/cm^2],

and,

$P = 37.7\ H^2$, where [H] = [A/m], [P] = [mW/cm^2], respectively.

Further Reading

1. ACG1H 1987–88.
2. Health and Welfare Canada Safety Code 6, 79-EHD-30.
3. National Research Council of Canada, *The Biological Effects of Radiofrequency and Microwave Radiation*, NRCC No. 16448.

Coming Events

April 11–14, 1989	BOHS Annual Conference. WARWICK, ENGLAND. For further information, contact: BOHS Secretariat, 1 St. Andrew's Place, Regent's Park, London, England, NW1 4LB.
April 17–20, 1989	IAQ-89: The Human Equation: Health and Comfort. SAN DIEGO, CA., U.S.A. For further information, contact: Jim Norman, Manager of Technical Services, ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA, U.S.A., 30329.
April 19–21, 1989	International Symposium: Vibration at Work. VIENNA, AUSTRIA. For further information, contact: Secretariat, Allgemeine Unfallversicherungsanstalt, Kongressbüro, Adalbert-Stifter-Strasse 65, A-1200 Wien, Austria. Phone: (0222) 3301/537, 3301/558, Telex 136074.
April 30–May 3, 1989	10th Annual Meeting of the Canadian Radiation Protection Association. VICTORIA, B.C., CANADA. For further information, contact: L.E. Moritz, TRIUMF, 4004 Westbrook Mall, Vancouver, B.C., Canada, V6T 2A3. Phone (604) 222-1047; Telex: (0)4508503; FAX: (604) 222-1047.
May 18–19, 1989	10th European Conference on Environmental Pollution. CAPRI, ITALY. For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
May 21–26, 1989	1989 American Industrial Hygiene Conference, ST. LOUIS, MO., U.S.A. For further information, contact: AIHC, 475 Wolf Ledges Pkwy., Akron, OH, U.S.A. 44311-1087, Phone (216) 762-7294.
May 22–26, 1989	Second Meeting of the International Neurotoxicology Association. SITGES, BARCELONA, SPAIN. For further information, contact: Dr. E.R. Farré, Secretariat II INA Meeting, Department of Pharmacology and Toxicology, CSIC, Jorge Girona Salgado, 18–26, E-08034 Barcelona, Spain.

May 31–June 2, 1989	Education and Training for Prevention: An International Symposium. PARIS, FRANCE. For further information, contact: M. Silberzahn, Caisse régional d'assurance maladie d'Ile-de-France, 17–19 place de l'Argonne, 75019, Paris, France.
June 5–9, 1989	Annual International Industrial Ergonomics and Safety Conference '89. CINCINNATI, OHIO, U.S.A. For further information, contact: Professor Anil Mital, Conference Chairman, Mechanical and Industrial Engineering Department, University of Cincinnati, Cincinnati, OH, U.S.A., 45221-0072. Phone: 513/475-6249 or 475-2738.
June 8–9, 1989	9th International Symposium on Environmental Pollution. TORONTO, ONTARIO, CANADA For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
June 13–15, 1989	Hazmat International '89. ATLANTIC CITY, NEW JERSEY, U.S.A. For further information, contact: Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E., Suite 408, Glen Ellyn, Illinois, U.S.A., 60137-5835.
June 20–22, 1989	Automated Analysis in Health and the Environment. STIRLING, SCOTLAND. For further information, contact: Royal Society of Chemistry, Burlington House, Piccadilly, London, England, W1V 0BN.
June 24–28, 1989	1989 Annual Meeting – American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). VANCOUVER, BRITISH COLUMBIA, CANADA. For further information, contact: Continuing Education and Chapter Programs, ASHRAE, 1791 Tullie Circle, N.E., Atlanta, GA, U.S.A., 30329. Phone: 404/636-8400.
July 10–13, 1989	Society of Occupational Medicine – Annual Conference. BRISTOL, ENGLAND. For further information, contact: SOM, 6 St. Andrew's Place, Regents Park, London, England, NW1 4LB.

August 28–30, 1989	International Conference on Blood-Borne Infections in the Workplace. STOCKHOLM, SWEDEN. For further information, contact: International Conference on Blood-Borne Infections, CONGREX AB, P.O. Box 5619, S-114 86 Stockholm, Sweden.
August 28–September 1, 1989	CLIMA 2000 – Second World Congress on heating, ventilation, air conditioning and refrigeration. SARAJEVO, YUGOSLAVIA. For further information, contact: CLIMA 2000, Masinski Fakultet, Prof. Dr. E. Kulic, 71000 Sarajevo, Omladinsko Staliste 66, Yugoslavia.
September 11–14, 1989	Work with Display Units 89. MONTREAL, QUEBEC, CANADA. For further information, contact: General Secretary, Institut de recherche en santé et en sécurité du travail du Québec (IRSST), 505, boulevard de Maisonneuve ouest, Montréal, Québec, Canada, H3A 3C2.
September 17–21, 1989	First World Congress on Accident and Injury Prevention. STOCKHOLM, SWEDEN. For further information, contact: Stockholm Convention Bureau, P.O. Box 6911, S-10239, Stockholm, Sweden. Phone +46-8-230990.
September 26–29, 1989	XVII Medichem. CRACOW, POLAND. For further information, contact: Institute of Occupational Medicine, P.O. Box 199, 8 Teresy St., 90-m950 Lodz, Poland.
October 3–6, 1989	Occupational Medical Association of Canada – Annual Meeting. HALIFAX, NOVA SCOTIA, CANADA. For further information, contact: Dr. F. Mills, Corporate Medical Director, John Labatt Ltd., P.O. Box 5870, London, Ontario, Canada N6A 5L3.
October 11–13, 1989	7th International Symposium on Epidemiology in Occupational Health. TOKYO, JAPAN. For further information, contact: Secretariat, 7th International Symposium on Epidemiology in Occupational Health, Department of Preventive Medicine and Public Health, School of Medicine, Keio University, 35 Shinano-machi, Shinjuku Ward, Tokyo 160, Japan.

November 16–17, 1989	International Conference on Air, Water and Environmental Pollution and Hazardous Wastes. NEW DELHI, INDIA. For further information, contact: Dr. V.M. Bhatnagar, P.O. Box 1779, Cornwall, Ontario, Canada, K6H 5V7.
May 6–11, 1990	XII World Congress on Occupational Safety and Health. HAMBURG, FRG. For further information, contact: Hamburg Messe und Congress GmbH, Postbox 302480, D-2000 Hamburg 36, Federal Republic of Germany.
July 29–August 3, 1990	5th International Conference on Indoor Air Quality and Climate. TORONTO, ONTARIO, CANADA. For further information, contact: Centre for Indoor Air Quality Research, University of Toronto, 223 College St., Toronto, Ontario, Canada, M5T 1R4.
September 22–29, 1990	23rd International Congress on Occupational Health. MONTREAL, QUEBEC, CANADA. For further information, contact: Dr. M. Lesage, Chairman of the Organizing Committee, 84 rue de Brésoles, Montréal, Québec, Canada, H2Y 1V5.

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